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# THE DEFORMITIES OF THE HUMAN BODY:

A SYSTEM OF

## ORTHOPÆDIC SURGERY,

BEING

A COURSE OF LECTURES DELIVERED AT ST. GEORGE'S HOSPITAL.

BY

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# PREFACE.

The following chapters were prepared as lectures, which were delivered at St. George's Hospital. Subsequently they appeared in the pages of the 'Lancet.' In their present form they are divided into three parts, namely, *Deformities of the Limbs*, *Affections of the Joints*, and *Deformities of the Trunk and Neck*, in the hope that this division of the subject may be useful to the student for whom this volume is especially intended.

Considering how much more attention is now paid to these subjects than was the case formerly, it will scarcely be thought superfluous to reissue these lectures in a distinct and separate form. And, indeed, I have been so frequently requested to do this, that an apology is scarcely necessary.

Whatever may be the shortcomings of the volume, my object will have been gained if it shall conduce to a more comprehensive understanding of the subject.

20, Grosvenor Street;
*October*, 1870.

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THE

# DEFORMITIES OF THE HUMAN BODY.

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## PART I.

## DEFORMITIES OF THE LIMBS.

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### CHAPTER I.

### INTRODUCTORY.

ORTHOPÆDIC surgery comprises the treatment of deformities of the trunk, neck, and extremities; such as club-foot in its several varieties, contractions of the limbs, curvatures of the spine, wry neck, deformities arising from rickets, and from cicatrices of burns, ankyloses, old dislocations, congenital dislocations, &c. Those deformities which arise during embryonic or fœtal life exist at birth, and are therefore termed *congenital;* while *non-congenital* deformities are acquired at any subsequent period of life.

NOTE.—The term Orthopædy is derived from ὀρθὸς, straight, and παιδῖον, a child, and was introduced into the language of science by Andry. "From these two words I compose," he says, "the term *orthopædy*, to express in one word the design which I propose to myself, of

Deformities occur, then, both as congenital and as non-congenital affections. Non-congenital deformities are, however, much more frequently met with than congenital deformities.

In these pages the subject will be treated in the following order, namely, in the first place an outline of the causes of congenital and non-congenital deformities will be given, and subsequently the various deformities of the human body will be considered in detail.

## CAUSES OF CONGENITAL DEFORMITIES.

Many causes have been assigned by various authors for congenital deformities, such as malformations and displacements of various portions of the skeleton; affections of the muscular system; malposition *in utero;* arrest of development, and disordered nervous influence.

*Disordered nervous influence.*—Rudolphi† first showed that club-hand and club-foot in the fœtus arise alone through morbid nervous influence on the muscular system.

Spasmodic action from cerebro-spinal irritation is, without doubt, the most frequent cause of congenital

inculcating the means of preventing and correcting in children the deformities of the body."*

* 'L'Orthopédie, ou l'Art de Prévenir et de Corriger dans les Enfans les Difformités du Corps,' par M. Andry, Conseiller du Roy, Lecteur et Professeur en Médecine au College Royal, Docteur Regent, et ancien Doyen de la Faculté de Médecine de Paris, tome i, p. 2, Préface, 1741.

† 'Grundriss der Physiologie,' 1823.

deformities which depend on muscular action. This spasm may be clonic, or it may be of a more permanent character. It is due to irritation; and whether this irritation be occasioned by dentition, by intestinal worms, or other cause, it may give rise to club-foot, club-hand, wry-neck, squinting or other deformities. It was written by Marshall Hall, "Dentition, as I understand the term, begins at birth or even before. It is then that the tissues of the alveolar processes and cavities become the seat of augmented vascular action and nervous excitement, which do not cease until dentition is completed. I think it probable that many convulsive affections and their dire effects have their origin in utero: certainly many of the latter are congenital."

But spasmodic action, however excited, may be transitory: the spasm may subside and a healthy condition may return. Under these circumstances the effects which are produced on the fœtus are less severe than when a similar spasmodic condition occurs after birth. It is not uncommon, however, that a partial recovery alone shall take place, and that after birth the child shall continue subject to spasmodic movements, the limbs not being entirely under the control of the will. Should irritation be persistent, paralysis, together with degeneration of the affected muscles, may probably ensue.

Again, in the anencephalic fœtus every known form of distortion may exist, as well as luxations, whether complete or incomplete; and similar distortions are also met with together with hydrocephalus and hydrorachis. There is, in fact, no known form

of distortion that does not occur with lesions such as these. Fig. 1 is taken from a hydrocephalic child in whom talipes varus and equino-varus were developed through cerebro-spinal irritation.

During fœtal life growth is remarkably rapid. Should spasm continue even for a short period only of fœtal existence, so that one set of muscles remains

FIG 1.

more or less contracted, their antagonists will be in an equal degree elongated and weakened, and the growth of the contracted muscles will not be in proportion to the rest of the limb. They are then said to have undergone *congenital structural shortening*.

Like other nervous affections congenital deformities are hereditary. Thus, I have known five boys in one family who have suffered with congenital talipes varus, their father, uncle, and paternal grandfather having likewise suffered from similar forms of distortion. In each generation females were added to this family, but none of them were deformed at birth. I have lately also seen another family of four children, two boys and two girls, all of whom were club-footed at birth: their mother also was club-footed.

Dr. Little, speaking of talipes varus, says: "I have traced it on the paternal side even through four generations—namely, the male infant, the father, the grandfather, and the great-grandfather."*

*Arrest of development* will occasion deformity, or even monstrosity; occurring as it may in a limb whilst growth elsewhere proceeds in a normal manner. Thus, if in the embryo growth be arrested, and this condition of parts be continued in the fœtus, it becomes monstrosity. For instance, a hand without fingers, or a foot without toes, would represent, according to Wagner, the conditions of those parts of the embryo at the seventh week of development. Should arrest of development take place in these parts at this period of existence, a form, which in the normal condition is transient only and confined to embryonic life, becomes, if continued, monstrosity in the child. Further, it has been shown by Wagner that up to the fourth or fifth month, or even later, the embryo may present

* Article "Orthopædic Surgery," in 'Holmes' System of Surgery.'

a club-footed appearance. But if arrest of development should occur at this period, so that the muscles on the inner side of the limb (say the adductors of the foot) cease to be developed in proportion to the rest of the limb, the condition now alluded to—the normal condition of the feet at this period—necessarily remains, and, as regards the affected muscles, development at birth is imperfect, and the feet still continue, as in the embryo, clubbed.

It is believed by some that intra-uterine pressure is the cause of congenital deformities. It should be remembered, however, that at an early period of gestation the embryo floats in the liquor amnii, and that as utero-gestation advances, and the fœtus becomes bent upon itself, the fluid which surrounds the fœtus prevents injurious pressure of the uterus, and enables those movements to take place which, indeed, become stronger and more marked until the period of gestation is completed. I have made use of the term "pressure of the uterus," but it is misapplied; for in its passive state, and until labour commences, the uterus exercises no pressure on the fœtus, but yields to every movement from within; and it is only when this passive condition is exchanged for one of action, to expel its contents, that the uterus exercises direct pressure on the fœtus. It is, therefore, impossible that the uterus should produce such pressure upon the fœtus during gestation as to induce deformity.*

* Professor Louis Bauer says, truly enough, that if intra-uterine pressure were a cause of club-foot, every child should be club-footed, for the foot is naturally inverted *in utero*. ('Lectures on Orthopædic Surgery,' p. 49.)

## CAUSES OF NON-CONGENITAL DEFORMITIES.

The causes of non-congenital deformities are various. Here, again, as in congenital deformities, disordered nervous influence is the prevailing cause; but, also, local inflammations, and debility are very frequent causes of non-congenital distortions.

*Spasm.*—During infancy spasmodic action is very frequently occasioned by dental and by intestinal irritation. Marshall Hall wrote:—"The age of convulsive diseases is specially that of dentition, and of what I may term dubious diet." Indeed, dental irritation is, perhaps, the most frequent cause of spasmodic action during infancy; and irritation of the sympathetic system of nerves through errors of diet, worms in the alimentary canal, retained feculent matter, &c., is often seen to give rise to spasm and convulsions. These forms of irritation are common during infancy, and they constitute at this period the most frequent causes of spasm and paralysis. Other causes of cerebral congestion and irritation of the spinal system of nerves exist, such as exposure to the sun's rays, the incubation of the exanthemata, a renal calculus, an insufficiently strangulated nævus; and, indeed, there is scarcely a condition of body that can be named, apart from health, in which convulsions may not be induced. Carpo-pedal spasm may exist without cerebral disturbance; but when irritation is continued, convulsions follow, with, perhaps, paralysis or death.

Spasmodic action is sometimes caused by pressure

upon the head of the infant during birth. The deformities which arise from this cause are doubtless frequently not distinguished from those which have been previously alluded to as congenital distortions. But tonic rigidity of a limb or of a pair of limbs (for the most part the lower limbs) or of the entire voluntary muscular system may result from some injury at birth, such as is sustained by the brain and the brain-case, or by the vertebræ and the spinal cord, by too much force in the application of instruments or without instrumental interference, when much violence is used, with or without deformity and contraction of the pelvis. In these cases the flexors and the adductors of the thighs, the flexors of the legs, and the extensors of the feet are very frequently affected. The upper limbs are usually less affected than the lower, yet the elbows will probably be found partially flexed, the forearms pronated, and the fingers wanting in power. The muscles of the neck are also in these cases deficient in power, and unable to support the head; so that the head rolls from side to side, and falls on to the breast or backwards. In the same manner the muscles of the trunk participate in the general weakness, and the child is in consequence unable to sit upright. In children thus affected there is also occasional or constant strabismus, and often the muscles of speech are involved: in some a cry only can be uttered, in others a syllable, while in others violent stuttering will be induced on the slightest provocation or almost without apparent excitement. Thus, a single muscle or a set of muscles or the entire voluntary muscular system may be affected,

and endless varieties of deformity are in this manner produced.

Such, then, are the forms in which spastic contractions are seen during infancy. Together with these spastic conditions of the arms and legs, there will probably also be found abnormal conditions of the feet and hands: indeed, every known form of talipes and cheirismus is to be found together with these rigid limbs. The accompanying figs., 2, 3, 4, were taken from a case in which this condition had been developed.

FIG. 2.

FIG. 3.

FIG. 4.

When convulsive action has once been developed spastic contraction may ensue or a limb may be wholly or partially paralysed. The countenance of the child usually indicates the presence of cerebral disturbance: there is a vacancy of expression, and the child remains dull and listless or otherwise it is excited. These children are, however, frequently more intelligent than a casual observer might suppose. Frequently the memory is good and the mind is tolerably active (although the child is always more or less morbidly excitable), notwithstanding that the fingers and feet are almost, if not quite, useless.

Spasm of one limb and paralysis of the opposite limb may be observed. Spasm is usually first developed in the upper, and later in the lower, extremities. It is often stated otherwise; but observation shows that in spasm the lower limb recovers power sooner than the upper; but that, when paralysed, the upper extremity usually first recovers power.

After a succession of slight convulsive attacks, certain muscles remain, perhaps, rigid; the most powerful being the most affected, or appearing to be most affected. Thus the thighs are more or less flexed and the knees are approximated, or even the legs are crossed one over the other and maintained so firmly in this position that considerable force may be inadequate to separate them; the legs are flexed, and the feet are extended and inverted. Also, the arms are bound to the sides, the forearms are flexed, the hands are prone, and the fingers are flexed. Every form of squinting may be observed

together with these rigid muscles; and, indeed, every voluntary muscle may equally be subject to this spasmodic action. As has already been said, this state of spastic rigidity may pass into paralysis.

Fig. 5 is taken from a cast which I placed in St. George's Hospital museum, in which are

Fig. 5.

represented almost every possible deformity to which spastic rigidity can give rise. Disease in this case was developed in infancy, and was con-

tinued, constantly increasing, until death, which occurred at twenty-five years of age. Any drawing can only give a very imperfect idea of the case. Here are seen talipes varus, talipes valgus, contractions of the knees, hips, elbows, wrists, fingers and toes, wry-neck, and lateral curvature of the spine.

Again, in the adult, affections of the sexual and the urinary organs occasion disorders of the brain and spinal cord, and give rise to deformities. Thus it is not uncommon to see hysteria associated with spasmodic contractions.

In cases such as these there has possibly existed some congestion of the spinal cord, which, having subsided, has left the deformity as a local affection, dependent alone on structural shortening of the affected muscles.* Not only may a hand or a foot or an arm or a leg be thus affected, but one side of the body or the entire muscular system may be involved in such cases as these.

*Paralysis.*—Paralysis presents itself especially in three forms—namely, that which arises from organic change in the nervous centres; that which is known as myogenic paralysis, or the essential paralysis of infants; and paralysis from traumatic lesion of nerve-trunks.

Paralysis, whether hemiplegia or paraplegia, is observed at every age as a consequence of organic change. During infancy, paralysis not unfrequently occurs without evident cerebral disturbance, perhaps

* See Remarks by Dr. Dick, 'Transactions of the Pathological Society of London,' vol. xv, p. 253.

during sleep or while a child is at play; and it often occurs without previous indication to an ordinary observer, the child appearing to be in his usual state of health. Thus, I have lately seen three cases which seemed to commence as follows. A child was playing in his father's garden, when suddenly he lost the power of his lower limbs: he was paraplegic. Another child was observed to squint: an epileptic seizure followed soon after, and this was succeeded by paralysis of both the upper and the lower extremities. A third child was convulsed, and remained unconscious for several hours: in this case hemiplegia resulted. Now, whether deformity is occasioned by spasm or by paralysis there is a certain amount of resemblance in the resulting distortion. For instance, paralysis of the sterno-mastoid muscle will cause the muscle of the opposite side to contract upon itself and thus to draw the head down towards the shoulder of the same side, at the same time that the chin is rotated in the opposite direction. And spasmodic action of the sterno-mastoid muscle also occasions a similar distortion. Again, when the muscles on the anterior surface of the leg become paralysed, such as the tibialis anticus and the extensor longus digitorum, their antagonists—namely the gastrocnemius and soleus, the tibialis posticus and flexor longus digitorum—gradually contract upon themselves, producing elevation of the heel with some inversion of the foot. And, as in the case to which I have already alluded, spasm of the extensors and the adductors of the foot produces a similar form of distortion. From long continuance in a contracted position and a more or less unused condition of the

muscles, structural shortening results; and ultimately fatty degeneration ensues, not of the paralysed muscles only, but also of those which are contracted.

In these cases of paralysis, a single muscle may alone be affected or a group of muscles or an entire limb may be deprived of power, or the power of one side may be lost, or both the upper and the lower extremities may be simultaneously paralysed. Florid children are, perhaps, scarcely less frequently the subjects of these attacks than those who are weak and ill-nourished.

Cerebral symptoms are, for the most part, preceded by spastic contractions. These premonitory symptoms—such for instance as squinting—are, however, frequently overlooked or their importance is not understood. The cause of irritation is consequently not recognised, and irreparable mischief, which might perhaps have been warded off, is allowed to occur.

Paralysis of one side of the trunk always gives rise to lateral curvature of the spine, the healthy muscles acting upon the vertebral column and drawing it away from the mesial line of the trunk. The length of the spinal curve will depend both on the extent and the degree of loss of muscular power: a single curve may be formed when paralysis is general on one side; but when it is confined to two or three muscles, the trapezius and the rhomboidei for instance, the curve will be compensated by a second curve. In the same manner, after amputation of the arm, the muscles of the shoulder become atrophic and lose their power; whereupon those of the other

shoulder, not being duly balanced, exercise undue influence on the spinal column and curve it in the direction of their combined forces.

Loss of the power of motion is, however, only one form of paralysis. Another and a somewhat more rare form is loss of sensation. This loss of sensation may occur in a patch of skin only or both lower extremities may be affected or it may be even more general. When loss of sensation is partial and incomplete, and perhaps confined to the lower extremities, walking is accomplished in a clumsy and awkward manner, with some support, such as a couple of sticks or an arm; but should such a patient close his eyes while standing, he would probably drop to the ground. The limbs cannot be guided without the help of the eye, and the ground is felt imperfectly, and is not grasped, if one may say so, by the feet. This form of paralysis passes on rapidly; and in many instances proceeds to the extinction of sensation.

*Infantile paralysis, or the essential paralysis of infants, or myogenic paralysis,* is frequently met with.

A child is observed perhaps to be feverish, and on the following morning, or in the course of twelve hours, febrile disturbance may have increased, and there will probably be superadded acute pain of one or more of the extremities, so that the child cannot bear the limbs to be touched. Then, after some few days, pain ceases, and the child begins again to move its limbs, but with difficulty, and without complete voluntary power: some of the muscles, or perhaps one or more limbs, remain paralysed. The lower limbs are affected in this

form of paralysis more frequently than the upper; and the extensors of the leg and the flexors and abductors of the foot are affected more commonly than any other groups of muscles. But in addition to these muscles of the lower extremities, the deltoid, trapezius, and rhomboids may be paralysed, as well, indeed, as the entire upper extremity. Sensation, however, is seldom impaired.

This form of paralysis usually occurs before the child is two years of age. It is often caused by exposure to cold—by throwing off the bed-clothes during sleep, by sitting on a stone seat, or other like cause. Although this form of paralysis is often preceded by febrile disturbance and local pain, it occurs perhaps even more frequently without pain, or with slight pain only.

This form of paralysis may take place without appreciable nervous lesion, or, again, the spinal cord may be affected in its entire length, and the nerves which are supplied to the paralysed muscles become atrophic.

When paralysis is recent, muscular power may, in a large number of instances, be restored by means of electricity, stimulation, and warmth; and even after the lapse of three or four years something may be done to improve the condition of the affected muscles, although it is scarcely possible that they should then regain their former power. Should, however, paralysis continue, contraction of the opponent muscles takes place, and deformity results.

*Traumatic lesion of nerve-trunks* is a rare cause of distortion. A nerve may be divided, and temporary paralysis will ensue. After a certain amount of

time muscular power will be re-established. But when a portion of a nerve is removed, paralysis will probably be permanent. Thus, I have known talipes calcaneus to be produced by the removal of a portion of the internal popliteal nerve, together with a tumour from the ham. Gunshot wounds also occasionally give rise to somewhat similar results. Such lesions are seldom remediable. Fortunately they occur but seldom.

Another and rare form of paralysis is that which has been described by Duchenne, under the head of *Paralysie musculaire pseudo-hypertrophique*, or *Paralysis with apparent muscular hypertrophy*. An excellent description of this affection has lately been given by Dr. Balthazar Foster.*

Duchenne divides the course of this disease into three stages, namely, 1st, muscular weakness; 2nd, muscular hypertrophy; 3rd, general paralysis.

The first stage usually, but not invariably, commences in early infancy, and may last for a variable time—months or years—and terminate in hypertrophy. This commences especially in the muscles of the calves of the legs, and extends to the gluteal and lumbar regions. In the upper extremity the biceps is also sometimes affected. Muscular weakness is often very great during this stage of the disease; but in the third stage it increases considerably and becomes even more general, so that the upper extremities grow weaker and the hypertrophied muscles waste. The patient cannot now walk nor stand, but drags himself about by the arms. I lately saw three members of a family who were affected in this

* 'The Lancet,' 1869.

manner. They consisted of two boys and a girl. The disease commenced in the elder boy when he was six years of age, and proceeded rapidly, so that in the space of five years hypertrophy of the affected muscles had disappeared, and wasting was complete. He retained great power in the upper limbs, and could pull himself up a flight of twenty stairs without excessive labouring. In the other two children the disease commenced during the first year, and at six and eight respectively they showed considerable hypertrophy of the gastrocnemii and the glutei, with talipes equinus. Boys are more frequently affected than girls with this form of disease.

Besides the causes already mentioned, inflammation and debility are common sources of non-congenital deformities.

*Inflammation.*—In the entire category of deformities to which I shall draw attention, none is more frightful to witness than that which may probably result from a severe burn. The chin is bound down perhaps upon the breast or, not unfrequently where destruction of the integument is somewhat more extensive, and consequently where contraction is somewhat greater, the lower lip is drawn down to its utmost limit: the saliva cannot then be retained, the teeth are forced outwards, and the aspect is rendered more repulsive even than in the former case. Loss of substance, where the destruction of integument is considerable, especially from burns, is followed by contraction and deformity; but the amount of deformity depends rather on the position than on the extent of the

injury. Burns of the neck produce perhaps the greatest amount of deformity, for contraction takes place with cicatrisation, and even after cicatrisation is complete; and although the face itself may not have been touched with fire, the mouth and eyelids being drawn down, the resulting deformity is very great. With the greatest care and attention, it is in many instances impossible to prevent deformity; yet something may always be done to prevent the terrible results to which allusion has now been made. When contraction takes place, the deformity may yet be remedied whilst the cicatrix is recent. There was lately a patient under my care, at St. George's Hospital, 60 years of age, who had been burnt extensively on the back and breast and in the axilla, and whose arm was bound down to her side by adhesions, so that she had no power to move it from her side nor to raise her hand; but by gradual extension she not only entirely regained the use of her arm, but the web which had formed wholly disappeared.

Again, a chilblain, or an ulcer, in healing, may occasion adhesions to form, which restrict motion and produce deformity. The muscles of the calf of the leg are more frequently affected than others in this manner. Incised and punctured wounds when they occasion suppurative inflammation, and gunshot wounds through destruction of tissue, also give rise to various deformities. And I must mention the viper-bite, although we rarely see any ill effects produced by it in this country; yet a notable instance lately came under my care at St. George's Hospital, in which the patient having been bitten

by one of these creatures, suffered from inflammation in several joints, which resulted in ankylosis; and contraction of the gastrocnemii took place, which necessitated the subcutaneous section of the tendons.

Lately also, another case came under my notice. It occurred in the person of a medical friend, who was bitten by a viper in the finger, whilst he was resident in the South of France. Very rapidly inflammation extended up the arm, suppuration took place in the finger and in the palm, and ankylosis of the second joint of the finger resulted.

Rheumatic inflammation, especially of the structures in the sole of the foot and in the palm of the hand, is of every-day occurrence. The fingers are drawn down into the palm of the hand, and the palmar fascia becomes thickened and contracted; and in a similar manner, though to a smaller extent, the plantar fascia also becomes affected. But, also, rheumatic and other forms of inflammation produce an extensive series of deformities through the disorganisations to which they give rise in the various articulations, occasioning permanent muscular contractions, with partial ankylosis, or, on the other hand, bony ankylosis may result when disorganisation is complete. Complete ankylosis is, however, rare.

*Debility* is one of the most common causes of deformity. Hence are produced flat foot, knock-knee, and curvature of the spine. Those who are compelled to stand for many successive hours, such as compositors, errand-boys, &c., are liable to contract this painful affection; the plantar ligaments

yielding and permitting the arches of the feet to sink. And in a similar manner the internal lateral ligament of the knee-joint yields, while the outer hamstring becomes tense; and thus knock-knee results. Again, during convalescence, and whilst growth is rapid, lateral curvature of the spine is very common. Thus a weakly child, if it be treated as a stronger companion, will probably acquire some irregularity of form; but the particular kind of deformity will depend on the habits of the child. Through standing or walking much, for instance, flat foot may be induced. This is a very common affection among children. A sense of weakness in the limb is caused by the loss of the arch of the foot, and consequently the child will probably stand more on one foot than on the other. Knock-knee will then be superadded. And should this occur to a greater extent in one limb than in the other, the pelvis will of necessity become oblique. But an oblique pelvis must induce curvature of the spine.

In infancy, posterior curvature of the spine is induced by debility. The muscles of the neck and back not having sufficient power to support the head and trunk, the head falls forward on to the breast, and the spine is curved forward in its entire length. Also in youth and in old age a stoop is induced by a similar cause.

The affections of the osseous system into which I have to inquire are rickets and scrofula.

*Rickets.*—In consequence of the derivation of the term rickets it is commonly supposed that this disease affects especially the vertebral column. It is

an error, however, to suppose that rickets frequently affects the spine. Sir Benjamin Brodie, in his lectures on 'Curvatures of the Spine,' which were delivered in the theatre of St. George's Hospital, said, "It was the prevailing opinion formerly, and I believe that some hold the opinion still, that the common cause of a lateral curvature of the spine is a rickety condition of the bones. This view of the pathology of the disease is not confirmed by the specimens preserved in the museums of morbid anatomy; and no one who has seen much of these cases in the living person can doubt that the fact is otherwise. We are not, therefore, justified in regarding rickets as the common, or even as a frequent, cause of spinal curvature; nevertheless, it is the cause of it in a few instances."

Rickets is seen not uncommonly at birth. Occasionally it occurs with some deficiency, as of one or more toes, with their corresponding metatarsal bones, or of fingers, with, perhaps, clefts through the palm to the carpus. Together with these abnormalities, partial displacement of an articular surface, as the knee, and talipes in some form, may perhaps exist. Also, in these cases of congenital rickets, it is not uncommon to find a peculiar and sharp projection of the tibia: so sharp, indeed, is the projection sometimes, that it appears almost as though the bone had been broken. There is also a corresponding indentation of the skin, as though it had been punctured. The softened bone is bent sharply, and the skin is thereby injured, and becomes more or less adherent to the periosteum. Figs. 6, 7, 8, 9, were taken from such a case.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

Rickets is rarely developed in the infant while it is being suckled by its mother—that is to say, whilst it is well fed and warmly clothed. When it is fed on vegetable and other indigestible matter disease begins to show itself. Rickets is a general disease, and not a disease of the skeleton only, and it abounds in all large and ill-fed communities: it is the result of poverty, bad food, and worse ventilation and drainage. Rickets is, for the most part, developed between the sixth and the eighteenth month; and it is seldom known to commence after puberty. I have tabulated 500 cases of this disease, and I find that female children are attacked considerably in excess of males, and also that the bones appear to be more extensively affected than in male children. Thus, of 28 cases of deformity of the pelvis, 2 only occurred in males. The following table shows, with sufficient accuracy, the periods at which rickets is seen to commence:

| | CASES. | |
|---|---|---|
| At birth . . . . . . . | 26 | |
| Between the second and the sixth month | 16 | |
| Between the sixth and the twelfth month | 229 | —271 |
| In the course of the second year . | 134 | |
| ,, ,, third year . | 43 | |
| ,, ,, fourth year . | 26 | |
| ,, ,, fifth year . . | 15 | |
| From the sixth to the twelfth year . | 11 | —229 |
| | | 500 |

Of these cases 326 were females and 174 were males.

From this table it will be seen that a large majority of cases of rickets occurs before the first year is complete.

When the disease has shown itself early, the child is languid and unable to stand. He then moves about on the floor in a sitting posture, and bends the arm bones by leaning on them; and in crawling the leg bones are curved above the malleolus as he pushes himself along the floor, and this bowing of the leg bones is increased when he is able to stand and bear the weight of the body upon his feet.

*Scrofula.*—In scrofula tuberculous matter is deposited in the medullary cavities and in the cancellous structure of the bones. The cancelli become dilated, and are filled with exudation, which eventually breaks down; abscess forms, and necrosis follows, with ulceration of the articular cartilages. In this disease the bones become soft and spongy; they are charged with oily matter; and are light in substance. Moreover, the blood-vessels are increased in size, so that when wounded, as occurs when portions of necrosed bone are removed, they bleed freely and often profusely. But, notwithstanding that a scrofulous bone becomes light and thin, and is deprived of some of its salts of lime, it never becomes curved, as in rickets. In these circumstances, the main distinctions between scrofula and rickets are to be found—namely, that in scrofula inflammation passes on to produce abscess, while in rickets abscess never occurs in the course of the disease; but curvature and deformity result.

Having now drawn attention to the causes of congenital and non-congenital deformities, I will proceed to consider in detail the various affections to which allusion has already been made; and will commence with the subject of Rickets.

## CHAPTER II.

### RICKETS.

RICKETS is essentially a disease of infancy: it occurs not uncommonly at birth; but it is observed especially during the first and second years of life. This disease was not described until the middle of the seventeenth century, when David Whistler selected the subject for his inaugural thesis, in 1645;* and Glisson, in 1651, made of it an elaborate study. At that time, as now, the affection was known by the name of rickets. It is probable that this term was formed either from the ancient French word *riquet* or from the German *rücken*.

Rickets is developed as a consequence of malnutrition. Hence it is that the disease is seldom seen whilst the child is being suckled at its mother's breast—that is to say, whilst it is kept warm and is well and sufficiently fed; but as soon as the food is insufficient or unsuitable, and the child is exposed to cold, then assimilation of food becomes imperfect, diarrhœa is frequent, the abdomen becomes tumid and night-sweats are observed, the child becomes weak and irritable, the muscles lose their consistence, and the skin acquires unusual sensitiveness. Then also commence to be seen swellings of the extremities

* 'De Morbo Puerili Anglorum.'

of the long bones and those further changes in the various textures of the body combined with deformities of the skeleton which together constitute rickets. Thus, rickets is comparatively rarely developed until about the sixth month of infantile life. From this time until the end of the second year more especially, those changes commence to take place through which are produced the deformities to which I shall allude.

Rickets is a general disease in which every tissue of the body is more or less involved; but the osseous system is more affected, or appears to be more affected, than any other tissue, in consequence of the deformities which are produced through the softening of the bones. Dr. Little has well expressed it thus:—"Rachitis is not solely a disease of the osseous system, but its effects are in this part more obvious, and therefore have been longer noticed. My opinion is," continues Dr. Little, "that every tissue of the frame is involved in the loss of tone and firmness—the bones, ligaments, the involuntary and voluntary muscles and their appendages, the membranes, and the glandular organs."* And Sir Wm. Jenner, in his admirable lectures, says: "In some books rickets is classed among diseases of the bones. This is a mistake. Rickets is no more a disease of the bones than is typhoid fever a disease of the intestines."† And he continues thus:—"Rickets being a general disease, the bones are affected as one organ, just as the arterial system is in the degeneration of age; the consequence of this is that no one bone is ever

* 'Lectures on the Deformities of the Human Frame,' p. 206. 1853.
† 'Medical Times and Gazette,' 1860.

affected without all suffering, and that whether the disease manifest itself chiefly by enlargement of the ends of the bones, or by softening of the bones, or by both in a proportionate degree." However well this opinion may satisfy the pathologist, it must be admitted that certain portions of the bony system appear to be affected sooner, and others later. Thus the enlargement of the wrist, which is always observed in rickets, is visible before any other affection of the bones is apparent. Rickets having commenced, doubtless disease proceeds to involve every tissue of the frame, if the conditions remain unfavorable to nutrition; but it is well known that this disease may be arrested, and that no further result shall appear than this swelling of the carpal extremity of the radius.

This swelling of the epiphyses of the radius and ulna may be considered to be characteristic of rickets. The malleoli and the knees also become swollen, though not so constantly as the wrist. I have seldom seen a case of rickets, however slight, in which the carpal extremity of the radius was not swollen. The bones throughout the skeleton become painful, and some of them are curved. Deformity takes place usually in the following order—namely, the tibia and fibula, the femur, the thorax, the clavicle, the spine, the radius and ulna, the humerus, the pelvis, and lastly the head and face. Guérin supposes that rickety deformity advances from below upwards; that the leg bones and the tarsal bones first show symptoms of disease, then the thigh bones and afterwards the pelvis and the spine—that a rickety spine necessarily involves rickety

deformity of the pelvis, thigh, leg, and tarsal bones.

As a rule, doubtless, the leg and thigh bones become curved sooner than the arm bones, in consequence of the weight of the body being thrown on to them, whilst the arm bones remain free. But this depends on the mode of progression. In the commencement of the disease the child may perhaps walk: he will then bend the tibia and fibula; and should he continue to walk, probably the femur also will yield. Then is produced what is termed *genu extrorsum*. But the disease may be developed before the child has begun to walk; and this is indeed exceedingly common. Then he will push himself along, while sitting, with one or other foot; and in this way will bend the tibia more or less sharply above the malleolus, and perhaps the radius and ulna above the wrist. Or, again, the arm and thigh bones may be much curved, while the leg bones and those of the fore-arms remain straight. It is sufficient to see such a child move about upon the floor to understand how such deformity is produced: the child does not walk, and never has walked; but it crawls about the room on its knees and supports itself on the elbows. Hence it is that in these cases the arm bones and the thigh bones are the only bones which are curved. And it is for the same reason that the leg and thigh bones are seen to be curved more frequently than other parts of the skeleton: because they have to bear the weight of the body. It frequently happens that after the leg and thigh bones have become somewhat curved they also become painful. It is in part because there is pain, and also

from a sense of weakness, that the child refuses to walk, and prefers to crawl about upon his knees and elbows or hands, and it is for this reason that the arms and forearms become curved as well as the lower extremities, as has been already explained.

The short bones become thickened in this affection, and, among others, the tarsal bones ; the ligaments also are softened, and allow the arch of the foot to drop ; and thus the superincumbent weight is transmitted especially to the inner edge of the foot. For the same reason the internal lateral ligament of the knee-joint has to bear a very unusual amount of downward pressure, and in consequence it yields ; and a very common affection—knock-knee—is thus produced.

In rickets the entire organism is more or less affected : growth is arrested and development is impeded. But it is more especially with the bony structures that we are at present concerned, and in these the most striking lesions are the enlargements of the epiphyses of the long bones, the thickening of the flat and the short bones, the softening and painful condition of the affected bones, and the deformities which result from mechanical causes.

Among the pathological changes which take place in the course of this affection are increased development of the spongy tissue of the epiphyses and of that portion of the cartilage in which calcareous matter is first deposited. Also the periosteum becomes thickened and vascular throughout the entire length of the bone, and especially at the extremities of the long bones—at the junction, namely, of the cartilage with the bone. The me-

dullary membrane becomes highly vascular, and a sanguinolent fluid occupies the medullary canal, the cancelli, and especially the epiphyses. The cells become distended, and are at length broken down, and the medullary cavities become chambers filled with bloody, pulpy matter, which will flow on cutting into the bone. The bones themselves become soft through diminution of their earthy salts, so that they readily bend, or even they may be cut with a knife. The salts of lime are taken up from originally well-constituted bones, and pass out of the system, especially in the urine; and the bones, especially the shafts of the long bones, are rendered extremely sensitive, so that pressure cannot be borne. In some rare instances the progress of the disease is so rapid that all the bones may become softened in the course of some few weeks.

This is the condition of the bones, then, in rickets; and out of this condition arise such deformities as flat-foot, bow-leg, and knock-knee, as well as curvatures of the arm, forearm, and spine. But it must not be supposed that every case of flat-foot, bow-leg, and knock-knee results from rickets; for similar forms of deformity are produced by general and local weakness and inability to sustain the weight of the body. In these, however, the characteristic mark of rickets—swelling of the epiphyses of the long bones—is absent.

When a bone is curved, it is so in consequence of its softened condition: it yields to the superincumbent weight. Thus the tibia and fibula become curved in an outward direction. This curve is an exaggeration of the normal curve as it is found in the young child.

All rachitic children are long in learning to walk, and instead of walking they push themselves along the floor in various ways, and thus each determines the form of curve peculiar to itself. For instance, one will use the outer side of the foot and leg, and curve the leg bones sharply above the outer malleolus; another moves about upon the knees, and curves the femur outwards; whilst, again, another will rest on the elbow and work itself along with the hand, and thus bend the humerus, and also the radius and ulna immediately above the wrist. These curves of the lower limbs are always considerably increased when the child stands. Then is produced, in addition, perhaps, to curvature of the femur, outward curvature of the tibia—genu extrorsum. Together with this weakness of the bones there is commonly associated corresponding weakness of the ligaments. The internal lateral ligament of the knee-joint yields, and the knee is inclined inwards—genu valgum, or knock-knee. Thus, there will be found knock-knee on one side, and bow-leg, or genu extrorsum, on the other; or, on the other hand, the same kind of deformity may be developed in both extremities; and this is indeed generally the case, while the former is the exception. The leg bones are somewhat similarly bent in each limb; or the thigh bones are bent; or the thigh bones and leg bones are together bent; or the knees are bent inwards.

When knock-knee exists, the weight of the body is transmitted more and more towards the inner edge of the foot, so that at length the ligaments in the sole of the foot yield, and the arch of the foot sinks, until little or no arch remains. But it is also

very common to find that in weak or rickety children the arch of the foot yields first and the knee later. The scaphoid and the cuneiform bones sink so as to lie upon the ground, and the consequent pressure of the soft structures in walking is painful, and causes an awkward and peculiar gait; the elasticity of the foot is destroyed, and its movements become much restricted; the abductors of the foot become retracted, and the foot is everted. Soon the ligaments of the ankle-joint yield, and there is often a greater sense of weakness about the ankle-joint even than in the foot itself. Now, also, the internal lateral ligament of the knee begins to yield, and the knee becomes inclined inwards somewhat in proportion to the deformity which has been produced in the corresponding foot; thus one knee may be more inverted than the other; as is shown in figure 10.

FIG. 10.

But, when this happens, the pelvis becomes oblique, and curvature of the spine necessarily follows.

*Treatment.*—The treatment of rickets consists in the employment of all such measures as conduce to the restoration of health—namely, warm clothing, such as flannel next to the skin and enveloping the trunk and extremities; a diet composed mainly of animal substances, and a dry and pure air. To these may be added tepid bathing, as well as cod-liver oil and one or other of the various preparations of iron. Constipation and diarrhœa, which are so frequently present in this affection, are to be combated, not by the exhibition of drugs, but by a careful regimen. It is rare, indeed, that strict attention to diet will not, at least in the commencement of rickets, be sufficient in itself to regulate the secretions, and restore a state of healthy nutrition; but should it not be sufficient to effect this purpose, then recourse may be had to the nitro-muriatic acid bath, which, when used occasionally, and as it may seem to be required, is of great value in these affections. We are mainly indebted to Sir Ranald Martin for the introduction of this remedy into this country. It is greatly to be preferred to the employment of purgatives and alteratives and various preparations of mercury with which these conditions essential to rickets are yet treated by some.

The *surgical treatment* of the deformities which are above described—namely, curvatures of the tibia and femur, and knock-knee—may be explained in very few words. It consists of the application of splints or supports to the bent limbs. These are

placed on the inner side of the curve, and pressure, by means of webbing bands, is thus readily applied to the outer side of the curve. In genu extrorsum, or outward inclination of the knee, the femur is curved outwardly as well as the tibia. In this deformity, therefore, the support should reach on the inner side of the curve to within two inches of the pubic bone. It should be made of metal, and as light as is compatible with the requisite strength, with a joint to correspond to the knee-joint, and its lower end should be inserted into a socket, which is let into the sole of the boot; while the upper portion is continued on the outer side from the knee to the hip, and connected with a band which passes around the pelvis. Where the bones of the leg alone are curved the support should reach from the inner condyle of the femur to be let into the sole of the boot, as in the case before mentioned. In both cases a pad should be so placed as to correspond to the internal malleolus, so that pressure may not cause injury to the integument. It is easy in this manner to remove this outward curve of the leg-bonés. But, together with an outward curve, there is not unfrequently found a forward curve also, and it is much more difficult to remove this anterior curve than it was to act on the outward curve. This anterior curve should be treated by means of a well-padded splint, and pressure should be made gradually, and increased very slowly; for in this position, the bone being sharp, and lying immediately beneath the skin, pressure would readily cause a slough. To act on such a curve efficiently, pressure should be exerted only in the horizontal

position, and the child should not be allowed to stand until the curve is removed. The same system is to be adopted in the application of splints to the humerus and the radius and ulna. In all these cases the apparatus should be provided with joints which correspond to the articulations of the limb, and which allow, consequently, of motion at the same time that such pressure as is necessary is applied to the curved bone. It is, of course, to be understood that this treatment, when applied to rickety bones, is to be used before nature's cure is effected; for as diarrhœa ceases together with night-sweats, and the functions of digestion are performed in a more healthy manner than heretofore, the epiphyses begin to diminish in size, and the salts of lime then are again deposited in the bones, so that they not only acquire their normal strength, but become endowed with much greater solidity and consistence than in their normal condition. The phosphate of lime is then deposited in abundance, especially on the inner side of the curve, and this deposition greatly increases the weight and strength of the bone. This is the cure which nature performs; and when this has been effected, the curves which existed remain unalterable. These observations apply, however, alone to rickety bones, and not to those curves which are induced in the long bones as a result of debility.

Genu valgum, or knock-knee, requires support on the outer side of the limb. This support is, perhaps, best given by means of a metal stem, which is fitted above into a band which encircles the pelvis, and below into the sole of the boot: joints correspond

to the articulations of the limb, and one or more bands support the knee. In severe cases it is advantageous to attach a cogwheel to such an instrument, that the direction of the stem may be altered as the limb yields. In cases where such an apparatus is necessary, the child should be kept in the horizontal posture during almost the whole day. Exercise may be allowed; but it should be used sparingly. In a severe case in the adult it is necessary to divide the outer hamstring.

## CHAPTER III.

### CONTRACTIONS OF THE LIMBS.

Contractions of the limbs may be general, as is seen in spastic rigidity from spinal irritation; or a limb or a portion of a limb only may be affected, through injury to the nervous system or from local injury or as a result of inflammation. Thus, spasmodic contraction may affect an upper or a lower extremity, or a hand or a foot only, or the entire muscular system may be involved. The muscles which are most frequently affected in this manner are the flexors and the adductors of the thighs, the flexors of the legs, the extensors and the adductors of the feet, the flexors of the arm, and the flexors of the wrist. But, besides these, a spastic condition of the muscles of the head and trunk, those of the orbit and of the organs of speech and deglutition, occasioning wry-neck and every form of spinal curvature, squinting, stuttering, and difficulty in swallowing, is also met with, following those lesions to which allusion has already been made.

Again, paralysis gives rise to distortions which bear in outward form a close resemblance to those which have been occasioned by spasm. For, as in spasm the flexors, adductors, and pronators of the limbs are more especially affected, so in

paralysis the opposed sets of muscles become more especially implicated—namely, the extensors, abductors, and supinators. And thus the wrist may, for instance, be flexed through spastic rigidity of the flexor muscles, or it may equally be flexed through paralysis of the extensor muscles and consequent contraction of their opponents. And in the same manner the foot may be affected with talipes varus through spasm of the gastrocnemius and the adductors, or it may equally be distorted into talipes varus through paralysis of the muscles on the front of the leg and the abductors, and the consequent retraction of their opponents. These morbid states, then—paralysis and spasm—are induced by irritation or by organic change in the nervous centres. The lesion may be congestion only, or effusion and softening may result.

But local inflammation is, perhaps, even a more common cause of contraction of limbs than nervous lesion. Inflammation of and around joints, whether it be in the form of rheumatism or scrofula, phlegmonous erysipelas or from mechanical injuries, gives rise to contraction of the limb, with more or less immobility.

I will now proceed to consider the various forms under which contractions of the limbs are met with, and afterwards will direct attention to the treatment of these results of spasm, paralysis, and inflammation, as they are brought before us in the deformities with which we have to deal. And because club-foot is of very frequent occurrence, and in the treatment of this deformity that of all other deformities may be said to be comprised, I will commence my descriptions of contractions of the limbs with the descrip-

tion of talipes, or club-foot, and then continue to treat of the various contractions which are met with of the lower extremity.

But, perhaps, before entering on the descriptions of these various forms of contractions of limbs, it may be well to devote a short space to the consideration of the re-union of tendons, seeing that these deformities are removed for the most part by division of one or more tendons in the commencement of the treatment.

## ON THE SECTION AND RE-UNION OF TENDONS.

At various times attempts have been made to remove deformities by the section of tendons. Thus, Thilenius, in the year 1784, divided the tendo Achillis, and Sartorius, in 1806, performed a similar operation. Michaelis followed in 1809, and operated on various occasions. He did not, however, cut the tendon across, as was done by Thilenius and Sartorius, but, having divided the tendon in part, he ruptured the remaining portion. Delpech, in 1816, next divided the Achilles tendon; and he divided it subcutaneously. For the details of these several operations I must refer to my work on 'The Nature and Treatment of Club-Foot,' 1856, p. 6.

Delpech wrote the following rules for the section and re-union of tendons. They are admirable, and may be said still to be recognised as the rules for the subcutaneous division of tendons:

"1st. The tendon to be divided should not be exposed; but its section should be made by inserting the knife at a distance from the tendon, and not by making an incision in the skin parallel to it. There is danger of exfoliation of the tendon unless this precaution be taken.

"2nd. Immediately after division of the tendon, the divided extremities of the tendon should be brought into contact and so be held by a suitable apparatus, until re-union is accomplished.

"3rd. As re-union can only take place by an intermediate fibrous substance (*organisation inodulaire*), gradual and careful extension should be made, to give the required length to the shortened muscles, before solidification takes place.

"4th. Extension being complete, the limb should be fixed in this position, and be so retained until the new substance has acquired that firmness of which it is susceptible."*

The author of these rules may well be said to be the originator of subcutaneous tenotomy.

Fifteen years after the operation by Delpech, and three years after the publication of his work on the subject, Stromeyer first divided the tendo Achillis.

Stromeyer published his 'Contributions to Operative Orthopædic Surgery,'† in 1838, in which the following occur as his rules for the performance of subcutaneous operations:

"When it can be done, the tendons of the resisting muscles must be divided; but when the tendons can be reached only with great difficulty, then the muscles themselves should be divided. The section should be made beneath the skin, when this is possible, and the skin itself should not be divided. Small instruments of different shapes are to be chosen for this purpose: generally, a moderately curved, sharp-pointed knife is the most useful. The limb should be so held that the tendon to be divided may be made to stand prominently forward; and the knife being passed behind the tendon, and the point of the knife having reached the opposite side, the resisting

* 'De l'Orthomorphie,' tome ii, p. 330, 1828.

† 'Beiträge zur Operativen Orthopädik,' Hannover, 1838.

tendon is to be divided rather by pressure against the edge of the knife, than by onward movement of the blade. The yielding skin follows on the blade of the knife, so that the two small wounds are only of the same breadth as the blade. I have very often divided the tendo Achillis with a single puncture of the skin; but this is unimportant, for the two small punctures heal as quickly as one only. Usually, a peculiar cracking noise is heard at the moment when the tendon is divided. Section of the tendon with the point of the knife is not always safe; partly, because the point is not sufficiently strong, but, also, because other structures may be wounded should the patient not remain quiet. Probe-pointed knives are quite useless. . . . . When many tendons are to be divided the sections should, if possible, be made at the same time, for extension is then accomplished with greater facility than when the operation has to be repeated."*

Stromeyer thus established the division of tendons on a secure and permanent basis, and ensured its reception as a standard operation in the art of surgery.

In the year 1836 Dr. Little, who from childhood had suffered from equino-varus, visited Stromeyer in Hanover, and was operated on by him. In his work† Dieffenbach gives an account of Dr. Little's return to Berlin after he had been operated on by Stromeyer; in the following words:

"A month had elapsed," writes Dieffenbach,

* Op. cit., p. 18.

† 'Ueber die Durchschneidung der Sehnen und Muskeln,' 1841.

"since Dr. Little had taken a letter from me to Dr. Stromeyer, in Hanover, when suddenly my door was opened, and the individual who had left me a cripple, entered with a vigorous and rapid step. I can scarcely tell which was greatest, my astonishment or my pleasure. I immediately examined his foot, and found the shape normal, the sole in contact with the ground, the arch of the foot diminished; the calf of the leg had begun to be developed, and the entire lower extremity had gained its normal length. A miracle could not have struck me more forcibly; and I confess I was never more taken by surprise in the whole course of my life at the successful result of a surgical operation than by this; and I esteemed Stromeyer, who had performed the operation, even more fortunate than Little, who had benefited by it."

Dr. Little chose, as the subject of his inaugural dissertation, talipes varus;* and soon afterwards returning to London, commenced that career on which his fame rests, and established in this country, by his example and writings, orthopædic surgery.

Jules Guérin contributed in France some excellent essays on orthopædy; and Duval, Bouvier, and Bonnet, among many others, have enriched this department of surgery. Mr. Tamplin and Mr. W. Adams have also written on this subject.

In connection with the treatment of deformities, numerous experiments have been made on the tendons of animals, to determine the mode of reunion after division. Some of the earliest were

* 'Symbolæ ad Talipedem Varum Cognoscendum,' Berol., 1837.

made by von Ammon, who published an elaborate work* on the subject with highly coloured and over-wrought plates, which, however, contained much excellent and truthful material. He was followed by Jules Guérin, Bouvier, Duval, Pirogoff, and others. Our own countryman, Herbert Mayo, had previously given the results of his experiments on animals. He did not operate, however, subcutaneously. Mr. Paget subsequently recorded a series of subcutaneous sections of tendons, and his record,† which is very precise, is of great value. The microscopical characters relating to the reparative process are given in considerable detail, and his representations are truthful records of the anatomical appearances which are presented. These may be seen in the museum of St. Bartholomew's Hospital. Gerstäcker and Boner about the same time also recorded a series of experiments of a similar kind; and Thierfelder made a like series of experiments with most carefully detailed results, together with the microscopical appearances which were presented in thirteen instances, of the reparative process and of the structural changes which were observed between the first and the fifty-sixth day.

There were some points which had not been clearly made out in the sections which had already been made, and therefore I determined to repeat to a certain extent what had already been done, and to observe the result of division and the structural changes which take place during the process of re-

* 'De Physiologia Tenotomiæ experimentis illustrata,' 1837.

† 'Lectures on Surgical Pathology,' vol. i, 1853.

union when the limb is placed under similar conditions as are observed in man. The results of my investigations were communicated to the Royal Society, together with the anatomical specimens themselves, and the drawings which were made from them.* They differed from those of Thierfelder, Paget, and others, in this respect, that instead of allowing the animal to move about after the section of the tendon had been made, the limb was kept at rest. The results which were obtained were intended to show, in the first place, the effects of immediate re-union of the divided tendon; and secondly to show how re-union takes place when gradual extension of the uniting medium is made. This mode of experimenting had not previously been adopted, and it had not been ascertained what was the condition of the new structure under these circumstances. Even in Mr. Paget's description a very important error had crept in, to which I will call attention.

Mr. W. Adams also made some sections of tendons about the same time. He followed the plan which had previously been adopted of dividing the tendon and allowing the animal immediately to move about. But the result of this mode of treatment is not satisfactory in its application to surgery. When this operation is performed in man, a splint is accurately bound to the limb and the limb is held in the same position as before the operation for a certain period. In some of the experiments made by Mr. Adams the new material was drawn out to a great

* These, together with the communication itself, are in the archives of the Royal Society.

length; and in consequence of the uniting medium being thus unduly attenuated, the muscle was deprived of power.*

My experiments, I repeat, were made on the same principle as the section of tendons for the removal of deformities is made in man; and the following details show the results. They were made on the Achilles tendons of twenty rabbits, and were divided into three series, viz. to show—

1st. That when a tendon has been divided it may re-unite without leaving a permanent cicatrix.

2nd. That the new material may be extended to any required length. When, however, the divided ends of the tendon are widely separated and kept apart, re-union will not take place.

3rd. That the new material does not impair the power of the muscle, except when it is so elongated as to prevent entirely or in part the action of the muscle.

* Mr. Tamplin referring to these experiments of Mr. Adams, says, "Of necessity, the union was most imperfect, and no more illustrates the actual union of tendons, where proper precautions are used, than the false union of bone after fracture under similar circumstances would illustrate the normal union of fractured bone." ("A Course of Lectures on the Nature and Treatment of Deformities," 'British Medical Journal,' 1860.)

RESULTS OF EXPERIMENTS.

1. The tendon was divided one inch from its insertion. The limb was then extended so as to approximate the divided ends of the tendon, and it was so held until re-union and consolidation had taken place. Two months having elapsed, the tendon was removed. A cicatrix was not observable externally upon the tendon. On making a longitudinal section of the tendon, however, a cupped depression was seen where the tendon had been cut across. After a more considerable lapse of time, namely, from three to four months, this depression in the tendon was no longer found.

2. When gradual extension after section of the tendon was made, as is done in man for the removal of deformity, the new material was drawn out to any required length. During consolidation contraction of the new material was always found to take place to a greater or less extent; but when extension of the uniting medium has been made the new material remains as a permanent structure.

3. When the new material which is deposited between the divided extremities of the tendon is extended slowly and gradually it may equal in diameter and strength the original tendon, and under the microscope it will at length not be distinguishable from it. It differs, however, in colour from the original structure, for instead of the uniform arrangement of fibres, and the pearly lustre of normal tendon, it presents a greyish, translucent appearance.

The process of re-union after the subcutaneous division of a tendon is as follows:

Immediately after the section of the tendon has been made, the muscle retracts, somewhat in proportion to the power of the muscle. Thus, in the instance of the tendo Achillis the upper portion of the tendon is retracted together with the muscle away from the wound, while the lower portion of the tendon remains opposite to the puncture. A clot or two of blood may be found in or about the sheath of the tendon, and especially in the immediate vicinity of the wound. The inflammatory product is usually of small amount, and the exudation ceases after twenty-four hours. The external puncture is closed by adhesion in from twelve to twenty-four hours.

On the second day a small and unimportant film of blood was found in the sheath of the tendon, and a small quantity of lymph was attached to the divided ends. On the third day the space between the divided ends of the tendon was equal to from three-fourths of an inch to one inch; the sheath was thickened and its vessels were injected; soft greyish lymph was attached to both extremities of the tendon, but especially to the upper divided end. On the fourth day this constituted a soft bond of union between the divided ends of the tendon, and the lymph was more or less blotched with blood. On the sixth day the ends of the tendon were more closely approximated, the intervening substance not being more than half an inch in length; it was well defined, firm, and ruddy, being streaked with blood. At this time the uniting medium was distinctly fibrous. The ends of the tendon, especially the

upper end, were enveloped in this new material to the extent of one fourth of an inch; they were also somewhat swollen, softened, and succulent. Occasionally an elongated clot of blood was found imbedded in this new material as an accidental product, which does not, however, appreciably hinder the healing process. On the tenth day the uniting medium had contracted to one fourth of an inch in length; it was softer, paler, and thicker than the normal tendon, but it was not less well defined, and it was at this time capable of very considerable resistance. The Achilles tendon of a rabbit would support a weight of eighty pounds.

The reparative process appears to proceed equally well whether the sheath of the tendon be entirely or in part only divided; yet the sheath is doubtless important in giving definition to the new product. In the experiments which I made, slight adhesions to the sheath were sometimes found to exist; in numerous instances, however, the tendon was free in its sheath. It was found that when the sheath was entirely divided it did not contract with the muscle, but it was always afterwards adherent. Each day adds to the strength and perfection of the intermediate substance.

If the limb be retained for a long period in a position to favour perfect re-union, contraction of the new material continues to take place until a bulbous enlargement alone marks the point of section. This, also, at length disappears, and no outward trace of the passage of the knife across the tendon itself remains. On making a longitudinal section of the tendon, however, a slight central depression may

be observed, which marks the point where the tendon was divided. This depression is at length also removed, so that the condition as it is described by Mr. Paget is obtained, namely, no trace of the division can be discerned even with microscopic aid.* Such, then, is the mode in which re-union takes place when the limb has been kept at perfect rest.†

* Mr. W. Adams has made a remark relative to these observations to the effect that the acme of perfection of the intermediate substance appears to consist in its total disappearance ('Reparative Process,' &c., p. 167). But, Mr. Adams forgot that two sets of experiments are referred to in my paper to show, in the first place, how direct re-union takes place, and secondly how union with intermediate substance is accomplished; and he has, therefore, overlooked the conclusion of my paper. He gives it, however, on a following page, thus:—"When the divided ends of the tendon are held in apposition, and the limb is kept at rest, re-union will take place without leaving a cicatrix; but when extension is made, the new material becomes organized and continues as a permanent structure." Ibid., p. 169.

† In reference to this subject Mr. Paget states that "Gradually perfecting itself, but with a rate of progress which becomes gradually less, the new tissue may become at last, in all appearance, identical with that of the original tendon. So it has happened in the valuable specimens presented to the museum of the college by Mr. Tamplin, Nos. 358, 359, 360, in the Museum. They are the Achilles tendon and the tendons of the anterior and posterior tibial muscles of a child nine months old, in whom, when it was five months old, all these tendons were divided for the cure of congenital varus. The child had perfect use of its feet after the operation, and when it died no trace of the division of any of the tendons could be discerned even with microscopic aid." ('Lectures on Surgical Pathology,' vol. i, p. 270.) This statement probably involves an error; for when a tendon has been divided and extension made, as for the removal of distortion, the new material becomes a permanent structure, and is scarcely distinguishable under the microscope from the original tendon, though it differs from it in colour and general appearance for a much longer period than four months.

Mr. Adams refers to these specimens as follows:—"In the museum of the Royal College of Surgeons are the tendo Achillis and the

When, however, extension has been made—as for the removal of distortion—or when the section of a tendon has been made and the limb has not been kept at rest, the new material becomes elongated, either according to the desire of the surgeon or, whilst in its soft extensible condition, through the unrestrained motions of the limb.

When these movements are excessive and take

anterior and posterior tibial tendons from a child, removed eighteen months after they had been divided for congenital varus, by Mr. Tamplin; and in these specimens it is said that no trace of the division and re-union could be detected, either by the naked eye or by the microscope. In the catalogue of the museum the following description is given of these preparations:

"'The tendo Achillis, and the tendons of the anterior and posterior tibial muscles of a child nineteen months old. They were all divided by subcutaneous section, nearly eighteen months before death. No trace of the division is discernible in any of them; their outlines and surfaces are regular, and their texture is uniform; even with the microscope no part could be found different from the rest.' ('Pathological Catalogue of the Museum of the Royal College of Surgeons,' vol. ii, Nos. 358, 359, and 360.)

"With regard to these last specimens, I have already stated, at page 66, that they were not examined, when recent, by a longitudinal section, the only method by which, at a late period, the difference between the old and new tendon can be recognised—the new tendon always preserving an appearance of greyish translucency, which contrasts with the opaque pearly lustre of the old tendon. I have also demonstrated the very close resemblance between the old and new tendon in microscopic characters, so that it cannot be said that the absence of new connective tissue in these specimens can be considered as proved. Moreover, sections of these tendons were made by Mr. Quekett and myself, some time ago, and there appeared to me to be some indications of new tissue in the tendo Achillis, but the traces were obscure from the effect of spirit, so that it was impossible to give a positive opinion." (Op. cit., p. 152.)

And again, Mr. Adams states (p. 118), "Mr. Tamplin's statement is not confirmed by my own dissections in the human subject, the result of which exhibits appearances very similar to those described in the late stages of these experiments on rabbits."

place soon after the division of the tendon, re-union may be wholly prevented.

While the new material remains soft and extensible it may be drawn out to any desired length, and thus it becomes a means of restoring the proportions of a limb when structural shortening has taken place. But that this new material may be formed of the required length and of equable dimensions it is essential that extension be made gradually; otherwise re-union may be imperfect or even it may be prevented from taking place. Or, again, the soft material may be drawn out to an inordinate length, as when extension is made too rapidly through want of experience in the use of mechanical means. Thus, paralysis, or weakness of a previously healthy muscle will be induced. In man I have known the divided ends of the Achilles tendon to be so widely separated after section of the tendon that re-union was prevented: the sheath of the tendon became thickened, but talipes calcaneus resulted. And in the dog I have known the new material to be extended fully six inches, while in the rabbit it has been lengthened four inches.

Thus, it is shown that re-union may take place under favorable circumstances without leaving a permanent cicatrix; while, on the other hand, it may take place through the formation of new tissue, which under certain conditions will remain permanently as an additional structure.

This new material may be extended to the required length and without impairing the strength of the tendon, if extension be made gradually and while the substance is still soft; but when extension is made

too rapidly the new material will be lengthened inordinately, and remain unfit for the purposes of the muscle. It then becomes only a slender uniting bond, which by its length impairs the power of the muscle.

# CHAPTER IV.

## TALIPES, OR CLUB-FOOT.

TALIPES occurs especially in four principal forms, or varieties, which are distinguished by the terms equinus, varus, valgus, and calcaneus. The word talipes is used as a generic term, and comprehends all those deformities of the feet which result from muscular and other contractions. But besides these specific forms, where the foot is directed downwards, inwards, outwards, or upwards, compound varieties, or intermediate forms, are met with, such as equino-varus, equino-valgus, calcaneo-varus, and calcaneo-valgus. Each of these varieties of talipes may be either of congenital or of non-congenital origin; and each form may depend on any one of the several causes already mentioned, such as spasm, paralysis, inflammation, &c.

### TALIPES EQUINUS.

Talipes equinus is more frequently met with than any other variety of talipes. It is essentially a non-congenital deformity; but it occurs also, though rarely, as a congenital affection.

Talipes equinus consists in the elevation of the

heel through morbid contraction of the muscles of the calf of the leg, the foot being neither inverted nor everted. Where this distortion occurs as a congenital affection, the other foot may also be distorted; and probably the hands may also be affected. Thus, in one instance which came under my care, there was talipes varus of one foot and talipes equinus of the other, as well as club-hands; or, again, one foot may alone be affected, as in the case from which Fig. 11 was taken. But the most extraordinary

FIG. 11.

instance of this kind of deformity is that from which Figs. 12 and 13 were taken, and which I saw with Mr. Lattey. In this instance talipes equinus was the only deformity present.

The child was well formed with the exception of the right foot; but on this foot there were eight toes. It was a large, broad foot, fully extended, and nearly

half as broad again as the other foot. A slight sulcus separated the heel into two equal parts, making two small heels. The most singular circumstance, however, connected with this deformity was that two Achilles tendons were inserted into this conjoint heel, and that both were large, well-developed tendons. The tendons were placed so far apart that it was necessary to introduce the knife a second time to divide the two tendons. The accompanying woodcuts (Figs. 12 and 13) show the

FIG. 12.

FIG. 13.

two aspects of the limb: one passive and the foot extended, while the other shows the muscles of the calf of the leg in action, and the toes bent towards the sole of the foot.

Although, then, talipes equinus occurs occasionally as a congenital affection, it is essentially known as a non-congenital deformity. The characters of the dis-

tortion are as follows :—The toes are pointed to the ground and the heel is raised, the muscles of the calf of the leg being retracted. The deformity varies in degree from inability to flex the foot beyond a right angle, to a vertical position of the foot, the heads of the metatarsal bones and the phalanges supporting the superincumbent weight.

Thus, the extremities of the metatarsal bones and the toes resting on the ground support the weight of the body ; and, in consequence, the metatarsal bones become slightly separated one from another, and the breadth of the anterior portion of the foot is increased. Fig. 14 is an example of severe talipes

FIG. 14.

equinus in advanced age. Here the separation of the phalanges may be observed.

When there is considerable loss of power in the muscles on the anterior surface of the leg, the foot may be retroverted, and even the entire dorsum of

the foot may rest on the ground, as is represented in Fig. 15. And when the muscles in the front of the leg are affected with spasm, the toes are drawn upwards and backwards; as is shown in Fig. 16.

FIG. 15.

FIG. 16.

There is still another form of this variety of distortion, with very little deformity, however, which is not-

withstanding occasionally, to say the least, extremely inconvenient, and which is known as rectangular contraction. In this condition, the foot cannot be raised beyond a right angle with the leg, and the anterior portion of the sole is pressed forcibly against the ground in walking. It is thus rendered tender and painful, and at length a callosity forms which induces lameness. Lately I had a patient in St. George's Hospital in whom a large callosity on the anterior portion of the sole of each foot had formed in the manner now indicated. The patient was admitted with inflammation of the sole, and the callosity in each foot was in a sloughing condition. Fig. 17 was taken from a case of this description.

Fig. 17.

When any lateral deviation of the foot is superadded to elevation of the heel, then other muscles than those of the calf of the leg are called into action, such as the adductors or the abductors of the

foot. Then we have a compound distortion produced, whether equino-varus or equino-valgus; and the special form of distortion is determined by the relative power of one or other set of muscles, or perhaps it is determined by the mode of transmission of the superincumbent weight, or by some other such cause. Figs. 18 and 19 represent equino-varus, and Fig. 20 equino-valgus.

FIG. 18.

FIG. 19.

FIG. 20.

Fig. 19 represents equino-varus of paralytic origin, while Fig. 18 is taken from an instance of spasmodic distortion.

*Pathological Anatomy.*—In this deformity the bones of the foot are altered in position rather than in form. This would *à priori* be expected to be the case, since it occurs for the most part as a non-congenital distortion.

The tuberosity of the os calcis is raised, partly in proportion to the amount of contraction of the muscles of the calf of the leg, but partly also in relation to the loss of power in the flexor muscles of the foot; and this altered position is also in part influenced by the period of life at which deformity commences, the displacement always being greater *cæteris paribus* when the deformity begins in early life.

An example of this distortion, the limb having been amputated, was sent to me by Mr. Hester, of Oxford. It was dissected and placed in the Museum

of the College of Surgeons (Pathological Series, No. 9, B), and the preparation was described at length in the 'Transactions of the Pathological Society,' vol. x, p. 279. Distortion commenced in this instance during the earliest period of infancy, and it increased gradually until the foot assumed a vertical direction. The plantar surface of the foot became deeply arched and the tuberosity of the os calcis was raised, through the contraction of the muscles of the calf of the leg, above its normal position, so that the upper edge of the tuberosity of the os calcis was raised three fourths of an inch above the extremity of the internal malleolus, and one inch above the tip of the external malleolus. These points are indicated, and the relative positions of the bones are well shown, in the accompanying plate, Fig. 21, which was taken from the dissected specimen.

Fig. 21.

An instance of so great deformity is not common; and in presenting it, therefore, I have been careful to state that it occurred in infancy, and as a consequence of paralysis. The relative positions of the bones of the leg and foot are accurately given in the accompanying plate. But, although this deformity occurred in early infancy and as a result of paralysis,

there is not anything very remarkable in the amount of deformity, for on referring to Figs. 11, 14, and 18, somewhat similar relations of the bones of the leg and foot may be observed. And, indeed, bearing in mind what has been above stated with regard to the age at which deformity commences and the amount of paralysis of the flexor muscles which may be present, somewhat similar positions are always maintained in this deformity.*

In consequence of the altered position of the os calcis, the tuberosity being raised by contraction of the muscles of the calf of the leg, the astragalus becomes forced forwards and downwards, and the head of the bone presents prominently beneath the skin on the dorsum of the foot. This is shown in Fig. 14. In extreme cases of vertical equinus ulceration of the superjacent skin even may be occasioned by the pressure of the head of the astragalus, and this absolutely occurred in the case from which Fig. 14 was taken. Such a condition is, however, exceedingly rare, and it can only occur when the distortion is thus exaggerated, whereby the head of the astragalus becomes inordinately prominent.

* It has been stated by Mr. W. Adams in reference to the position of the os calcis in equino-varus that "the os calcis is found, upon dissection, to deviate very slightly from its natural horizontal position." 'Transactions of the Pathological Society,' vol. viii, p. 396; and in his Jacksonian Essay 'On Club-Foot,' p. 83, he supports this position. I would refer those who are interested in this subject to the specimen above alluded to in the College Museum, the measurements from which were made by Professor Quekett and Mr. Murie. As regards the displacement of the os calcis, I agree with Mr. Adams that it is not material whether the deformity be true talipes equinus or equino-varus.

The muscles undergo change, varying in every possible manner from a condition of health to that in which entire destruction of their proper tissue takes place, and there is substituted, for healthy muscular fibre, fatty and fibrous degeneration. These changes are most marked in cases of paralytic origin. In the instance above cited, and from which Fig. 21 was taken, all the muscles of the leg and foot were in an extremely advanced stage of fatty degeneration: those situated on the anterior aspect of the leg were of a pale yellow and fawn colour, and had still the fasciculated appearance of muscle; whereas those in the posterior region were more agglutinated, and were not to be distinguished from a mass of fat. The tendons, also, were considerably diminished in volume.

The *extensor longus digitorum* was composed almost entirely of areolar tissue: degeneration of the muscular fibres was complete. No healthy muscular structure remained, but there was found a honeycomb structure of large fat globules, the interstices being filled with innumerable granules and other fatty matter.

In the *tibialis anticus* muscular transverse striæ were visible; but the greatest number of fibrils were filled with granular fatty molecules. The larger fibres broke into a series of squares, as though they were brittle. Between these, series of large fat globules were seen. In the lowest part of the muscle, which was more yellow and fatty in external aspect, few fibres could be distinguished, and in them striæ were not visible. The mass consisted chiefly of a meshwork of areolar tissue and fatty

matter with cells containing crystals of margaric acid.

*Extensor proprius pollicis.*—No muscular striæ were visible. The fibres were filled with oil globules. There existed much areolar tissue and large fat cells.

*Gastrocnemius.*—Muscular fibres were abundant, striated and healthy. The areolar tissue was in moderate quantity; and between the fibres, large fat cells, containing crystals, existed: these latter were very abundant.

The *soleus*, as a mass, was like a lump of fat; yet here and there were portions of a deeper fawn colour. In these, healthy muscular fibres were seen in abundance, mingled with others, containing molecules of fat. One or two fibres exhibited a breaking up into transverse laminæ, such as has been already described by Mr. Quekett, as "broken into short lengths." In some portions which were examined, there were not any large fat globules present. In others of a yellower shade, but few muscular fibres were found, and these contained oil molecules; but the mass chiefly consisted of areolar tissue and large fat-cells, many of which contained crystals of margaric acid.

In the *tibialis posticus* few or no muscular fibres were found, but areolar tissue, fat-cells (containing crystals of margaric acid), and oil globules.

The structure of the *flexor longus digitorum* was nearly similar to that of the last described muscle: there were traces of muscular fibres, but they were entirely converted into molecular fatty matter.

The outer aspect of the *flexor longus pollicis* was

analogous to the preceding. One small patch of reddish muscle-like substance remained, which consisted almost entirely of healthy striated muscular tissue. Some fibres were in the first stage of fatty degeneration: oil globules were mingled among or between the fibres. In other portions of the muscle no striated fibres remained, and there was but slight appearance of muscular tissue; but areolar tissue and fat only. The few fibres which were found contained molecular fatty matter.

The *peroneus longus* consisted chiefly of fibrous areolar tissue, together with large-sized fat-cells, containing crystals and other fatty matter. The muscular fibres were as though converted into a granular membrane.

The *peroneus brevis* presented very few muscular fibres, and no striæ were visible. It was full of oily matter: large globules, containing crystals, were arranged in honeycomb form, together with other fatty elements floating about.

Also the bones of the foot were softened and fragile. A very thin layer of cartilage alone remained to cover the articular surface of the astragalus; and the outer shell of the bone itself was no thicker than the cartilage; whilst the cancellous tissue was a mass of fat and oil, with some few spicules of bone interspersed.

*Treatment.*—The treatment of talipes equinus consists of the restoration of the shape of the foot by the division of the tendo Achillis, and the subsequent gradual extension of the new material which is deposited between the divided ends of the tendon, until the

foot can be well and sufficiently flexed upon the leg. Occasionally, however, the limb may be restored to its normal position, and distortion may be efficiently removed by mechanical means alone and without the use of the knife. This is especially the case where the distortion results either from paralysis or spasm, and especially where it is slight only. When the distortion is severe, the tendo Achillis must be divided.

The tendo Achillis is usually divided from one inch to an inch and a half above its insertion. The tenotome should be passed beneath the tendon from the outer to the inner side of the foot; and the edge of the knife being then turned upwards towards the tendon, and the tendon at the same time being made tense, the knife will be drawn across the tendon, making a clean transverse cut. Care must be taken not to draw the knife through the skin covering the tendon. If the limb be so held that the tendon is left lax, it may be difficult to divide the tendon; but if, on the other hand, too much force be used the divided ends of the tendon will be drawn asunder forcibly, and the integument will be drawn on to the operator's knife: it will then require some skill to avoid dividing the covering skin.

Scarpa's shoe is the instrument ordinarily used in the treatment of this deformity. It may be applied as soon as the puncture has healed, on the fourth day namely; and extension may be carried on slowly and gradually until it is complete in about six weeks. Should extension not be sufficiently rapid, at the end of six weeks distortion will only be in part removed; but, on the other hand, should extension

be made too rapidly or forcibly, the uniting medium may be drawn out so as to destroy the power of the gastrocnemius, and calcaneus will then result.

The restoration of function is scarcely less important than the restoration of position in cases of deformity which come under treatment. No greater mistake can be made than to suppose that all that is required of the surgeon is to remove an inconvenient or ugly position of a limb. Until he has restored some degree of power to use the limb as nature intended, he has conferred but a small benefit by the restoration of position. Electricity, shampooing, and baths, as they may seem necessary, are to be recommended in these and similar cases of deformity, and their use is to be continued until such power as can be regained is restored.*

* I would particularly direct attention to some valuable lectures on electricity which have lately been given by Dr. Russell Reynolds, and reported in the 'Lancet.' In connection with this subject, they are of considerable importance, and may be consulted with advantage.

## CHAPTER V.

### TALIPES VARUS.

It has already been stated that varus, as well as every other form of talipes, occurs both as a congenital and as a non-congenital affection; but as it was shown that equinus is essentially a non-congenital distortion, so it must be now said that varus is especially that form of talipes which is most commonly met with at birth. In congenital varus one foot or both may be distorted; it is, however, somewhat more usual to find both feet affected rather than one only, Where only one foot is distorted, the right appears to suffer twice as often as the left, and the male child is affected with congenital talipes three times more frequently than the female. In a report which was lately made to the French Government it was stated that nearly 13,000 cases of talipes existed in France. It is probable that in this country the number of cases from every cause is relatively larger even than in France.

In talipes varus the foot undergoes a threefold alteration in its position in relation to the leg, as was first clearly pointed out by Dr. Little—namely, extension, rotation, and adduction. The essential external character of varus, however, is, as its name

implies, inversion of the foot; and this may exist, though it is rare, without extension or rotation.

In congenital varus, as it is ordinarily seen (Fig. 22), the heel is raised (extension), the toes are directed inwards (inversion), and the inner margin of the foot is raised (rotation). But although this, as it is now described, may be looked upon as the type of talipes varus, several degrees of distortion occur, which are described in treatises on the subject as grades. Thus, there may be retraction of the tibialis anticus muscle alone, producing slight inversion of the anterior portion of the foot; and to this may be added contraction

Fig. 22.

of the plantar fascia, through which the length of the foot is diminished, as is seen in Figs. 23 and 24. Or again, the inner edge of the foot is raised, the toes are inverted, and the heel is elevated. This grade of distortion depends on retraction of the gastrocnemius and the tibialis anticus and posticus muscles, as is

shown in Figs. 25 and 26. The third grade is that which has been already described as the ordinary form of congenital varus, and as is shown in Fig. 22; while the fourth grade is the most exaggerated form of varus that is met with; where, perhaps,

FIG. 23.

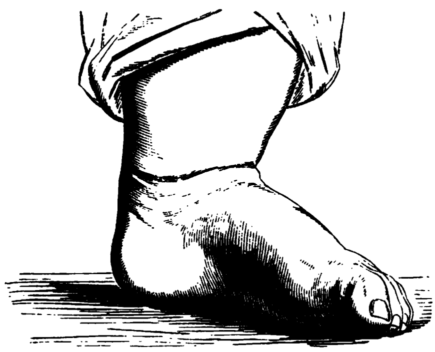
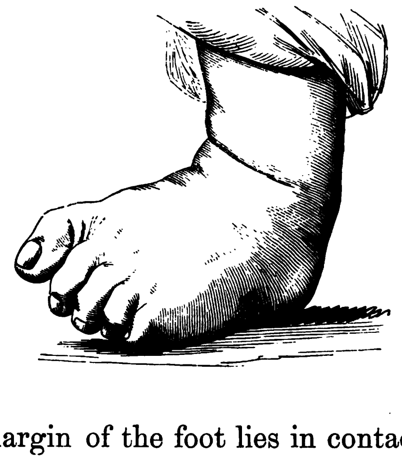


FIG. 24.



the inner margin of the foot lies in contact with the inner side of the leg, and the toes present directly upwards or are bent backwards; the heel is drawn

up, and the dorsum of the foot is directed downwards and forwards, as is represented in Fig. 27. The tendo Achillis appears to be deflected from its

Fig. 25.

Fig. 26.

ordinary position, and lies, in some of these instances of severe distortion, immediately over the posterior tibial vessels; the plantar fascia is shortened, and the muscles in the sole of the foot, as well as the extensors and the adductors of the foot and the flexors of the toes, are rigidly contracted. The muscles, then, which are principally concerned

FIG. 27.

in producing this affection are those of the calf of the leg and the tibial muscles; while, on the other hand, the extensor longus digitorum and the peronei become weak and attenuated.

In a severe case of talipes varus some rotation of the tarsal bones is found to exist at birth; this is easily overcome, however, and the foot is restored to its normal shape by careful and gentle treatment.

Together with excessive distortion some malformation of the tarsal bones may be found, which may offer serious and even insuperable impediments to the complete removal of distortion. These, however, are rare and exceptional cases.

When the weight of the body begins to be borne on the foot, as in walking, important changes commence, which should be thoroughly understood. The superincumbent weight is transmitted, not through the arch of the foot, as in the normal position of the limb, but it is received on the outer margin of the foot. The metatarsal bones, from want of adequate support, become folded, or doubled into the sole of the foot, and thus a broader surface is gained for support; and a soft cushion, composed of fat and cellular tissue, is developed, which enables the weight to be more easily borne; and this is often so large and perfect that it forms an excellent rest and enables the body to be borne almost as easily as in the normal position of the foot. This cushion is, therefore, of great importance to any one afflicted with varus. In non-congenital varus this cushion, or pad, is never well developed, and, in consequence, walking is always more or less painful. Both in congenital and in non-congenital varus this cushion inflames readily through over-walking or through exposure to cold, and it will then probably slough. It disappears entirely after the inversion of the foot has been removed, when the sole, instead of the outer margin of the foot, is placed in contact with the ground: its function has then ceased, and it, in consequence, ceases to exist. Not only may the fifth metatarsal bone be doubled

into the sole, but the fourth also becomes folded in with it; so that at length the weight is no longer transmitted to the outer margin, but to the dorsum of the foot. (These appearances are well shown in Figs. 28 and 29.) And, indeed, rotation of the foot

Fig. 28.

Fig. 29.

may be so complete that the astragalus has mainly to bear the weight of the body in walking, as is shown in Figs. 30 and 31.

In the adult, every structure entering into the

formation of the limb may undergo degeneration. The bones of the leg and foot become light and their walls become thin, and the tarsal bones are some-

FIG. 30.

FIG. 31.

what altered in form, especially the astragalus and the cuboid bone; the muscles also become atrophied through inaction, and after the restoration of

the limb to its normal form they remain small, but their functions are restored. If, however, motion be not restored as well as the normal position of the limb, fatty degeneration of the muscles ensues. I have already alluded to the description of an old-standing case (fifty years) of equino-varus at p. 63, and have described the pathological changes which take place. I have also stated that these changes in the structures occur more readily and earlier in non-congenital than in congenital varus. Indeed, in non-congenital varus or equino-varus of forty years' standing, muscular degeneration will probably be found already far advanced, and at fifty, as in the case to which I have just referred, there may remain scarcely a trace of muscular fibre.

## NON-CONGENITAL TALIPES VARUS.

Non-congenital talipes varus may readily be distinguished from congenital varus; for there is present either a condition of spasm or, on the other hand, paralysis (see Fig. 32); or, again, the distor-

FIG. 32.

tion may have been induced by loss of substance, such as is occasioned by a burn or, as in the case from which Fig. 33 was taken, by a lacerated wound. There may, therefore, be either more or less rigidity than is found in congenital varus, or there may be cicatrices. The general outline of the limb is, under these circumstances, less regular, the temperature is ill-maintained, and the limb is in con-

sequence liable to inflame and ulcerate; yet, as would be supposed, the outward appearance of the distortion is not dissimilar to the congenital form. It is always a painful distortion, for the callosity on which the superincumbent weight is borne is ill-developed, and, through pressure or cold, this pad is liable to slough. Such limbs are occasionally amputated, in consequence of the troublesome sores which are not unfrequently produced.

FIG. 33.

*Treatment.*—The treatment of varus should commence within some few weeks of birth. Nothing is gained by delaying the operation; but, on the contrary, through delay more time is required to produce an equally successful result. From one to two months after birth is the time which should be selected for the operation.

In very slight cases the distortion may be removed

by bandaging and passive movements of the limb: such treatment is long, however, and often it is unsatisfactory. In an ordinary case of varus, however, the distortion cannot be removed by such means. With regard to mechanical treatment, Phillips says: "In the first degree of varus in infants, the foot may be restored without the division of tendons, and through the use of an instrument for extension only; but such treatment is both difficult of execution and occupies much time, it is often painful, and it is rarely efficacious. In every case, even the most simple, it is better to divide the tendons."

The tendons which require to be divided in talipes varus are those of the tibialis posticus and the tibialis anticus muscles, and the tendo Achillis. And in dividing these tendons it is right to remember that, varus being a compound distortion, its removal must be effected by various stages. Thus, inversion of the foot should first be overcome, after the tendons of the tibial muscles have been divided: the distortion is thus reduced to the condition of equinus. In infantile varus the plantar fascia is seldom contracted or it is seldom so much contracted as to require division; but when it has to be divided, this should be done before the section of the tendo Achillis is effected.

In dividing the tendon to be operated on, the knife should first be passed well beneath it; and the cutting edge being then turned towards the tendon, this will be divided transversely on extending the limb. Some operators cut down upon the tendon instead of cutting upwards or towards the surface, believing this to be the simpler method. It is a

mistaken notion, however, for not only is the mode which I have indicated easier to perform, but effusion of blood is spared by adopting this mode of division of tendons. If not always entirely bloodless, this operation is for the most part so; but it is difficult to avoid wounding vessels when the knife is used to cut down upon a tendon, and frequently under these circumstances the effusion of blood is not inconsiderable.

To divide the tendon of the tibialis posticus muscle, the tenotome should be passed down to the edge of the tibia, at from three quarters of an inch to one inch above the malleolus, and the sheath of the tendon be opened freely, without enlarging the external puncture. The rounded knife may then be passed into the wound, and, guided by the edge of the bone, be directed beneath the tendon. In the adult, the tendon being prominent and easily felt, the sharp-pointed knife may be slipped beneath the tendon immediately that the sheath has been opened; but in infants it is safer not to use a pointed knife for the division of the tendon.

The anterior tibial tendon should be divided immediately after the posterior tibial has been divided. The knife should be passed beneath the tendon from without inwards as it passes over the ankle-joint, and the puncture should be made close to the tendon, that the artery may not be divided. Occasionally, the anterior tibial is more tensely contracted than the posterior; in which case it should be divided first.

It is of real importance that the tendons now mentioned—namely, the tibial tendons and the

tendo Achillis—should be completely divided, so that the restoration of the shape of the foot should proceed without hindrance. Should the tendon be transfixed, and consequently only in part divided, the treatment would be rendered, at least in a large number of cases, nugatory.

The division of the tendo Achillis has already been spoken of; and it is, therefore, unnecessary again to allude to it. Before, however, this tendon is divided, the mechanical treatment of varus must be undertaken.

After a tendon has been divided subcutaneously, the puncture is immediately to be closed with a morsel of lint, and the limb, having been bandaged, is to be bound to a well-padded, flexible metallic splint. It is a rule which should always be observed to place the limb, after division of the tendons, in the same position as before the operation; consequently, the splint is to be bent to the angle which the distortion represented, and bound on the inner side of the foot. When the punctures have healed—on the third or fourth day—the splint is to be removed, and one similar in kind, but longer, is to be applied on the outer side of the leg and foot. Even though a slight degree of traction alone be employed, it will be found that in the course of three days the foot will have yielded more, perhaps, than could have been expected from the amount of tension which may have been exerted. On replacing the splint the same effect will be produced, until at length the foot is fully everted.

But if in the infant it is important to deal with talipes varus as a compound distortion, and divide

the treatment into stages, it is of much greater moment to attend to this injunction when the patient is older; for, should the Achilles tendon be divided before inversion of the foot is removed, it may be impossible to bring the tarsal bones into their normal positions and to unfold the longitudinal and transverse arches of the foot. It is therefore the rule not to divide the tendo Achillis, whether in infantile or in adult varus, until the foot has been fully everted. Although rotation of the anterior portion of the foot may only be slight, yet the difficulty of removing this rotation, and of replacing the bones in their normal positions, would be greatly increased by dividing the tendo Achillis; for in doing this the fixed position of the os calcis is destroyed.

A straight, well-padded splint, carried to the knee on the outer side of the leg, and extending beyond the foot, is sufficient to remove inversion in a large number of instances of varus; but it is obvious that such an instrument is but ill-adapted to its purpose, and in severe deformity it is entirely inefficient. The instrument to be employed in this as in every case of distortion should be constructed in accordance with the mechanical relations of the parts to which it is to be applied, and the centres of motion should correspond as nearly as possible with the centre of motion of the articulation to be acted on. Scarpa's shoe clearly does not fulfil this desideratum; but a modification of it, which is now in general use and is made by all instrument-makers, fulfils this purpose.

The plantar fascia, when contracted, should be

divided before the support of the Achilles tendon is removed from the os calcis, whether in infantile or in adult varus; otherwise the longitudinal arch of the foot can scarcely be fully expanded. It is rare, however, that the plantar fascia requires to be divided in the infant; yet occasionally the central portion of the fascia may require division, or the inner band of fascia may alone be contracted. In either case the contracted portions should be fully divided. In the adult the plantar fascia offers a serious impediment to the restoration of the shape of the foot, and requires to be freely divided.

After the deformity has been removed, active and passive exercises of the limb, together with friction, galvanism, bathing, and other like means, must be employed, until easy if not complete power of motion is gained; for if the shape of the foot alone is restored, and the power to move it is overlooked, the patient will walk, but without elasticity and without motion at the ankle-joint; and then distortion, to a slight extent at least, will recur, and the tendons will again require to be divided. Thus it is that the treatment of talipes varus consists of, in the first place, the removal of the distortion; and secondly, the restoration of the functions of the limb.

## CHAPTER VI.

### TALIPES VALGUS.

TALIPES VALGUS occurs very frequently as a non-congenital affection, but more rarely as a congenital deformity. Its external characters are expressed in the name by which it is known, and which signifies that the foot is twisted outwards. The outer margin of the foot is raised, while the inner edge rests on the ground. The foot is flattened, its arches being more or less obliterated, and it is everted. Thus, talipes valgus is in some sort the reverse of talipes varus.

The accompanying figure (Fig. 34) represents a

FIG. 34.

somewhat severe form of congenital valgus; but even in such a case there is seldom found any deformity of the tarsal bones. Some of the bones deviate from their normal positions—as, for instance, the os calcis, which in such a case is drawn upwards by the violent retraction of the muscles of the calf of the leg; and in proportion as the tuber calcis is raised, so is the astragalus extruded from beneath the tibia. But the foot is also abducted; and therefore there must be a certain amount of rotation of the scaphoid and the cuboid bones, which in severe distortion always exists. This is produced by the action of the peronei. Again, the foot becomes flexed upon the leg, and the anterior portion of the foot is raised, as well as everted, through the action of the extensor longus digitorum, as is represented in Fig. 35. Thus, there is

Fig. 35.

abduction, rotation, and flexion of the foot; and, in addition, the os calcis is elevated.

## NON-CONGENITAL TALIPES VALGUS.

In non-congenital as in congenital valgus the longitudinal and transverse arches of the foot are obliterated, so that the sole of the foot rests with its inner margin flat on the ground. At first this flattening is only observed when the weight of the body is borne on the feet, as in standing; and on removing the superincumbent weight, the natural arches are, at least in part, restored. At length, however, the elasticity of the structures is lost, and the foot remains flat. This condition is very frequently met with in young and delicate persons with lax fibre. The tarsal ligaments in the sole of the foot yield and become elongated; and, especially under certain conditions, the deformity may increase so much as to produce a convex surface towards the ground—reversing, in fact, the natural arches of the foot. This is especially the case where much standing is required; and thus certain trades are more prone than others to this flattened state of the feet. Figs. 36 and 37 are illustrations of more or less severe forms of non-congenital talipes valgus.

Talipes valgus also results from paralysis, the tibial muscles, one or both, having lost power. This occurs especially as a sequel of infantile paralysis.

Spasmodic valgus is comparatively rare. It remains as a sequel after convulsive action, which may have

been excited in childhood through dental or other irritation; just as equinus may remain or varus or

FIG. 36.

FIG. 37.

strabismus, or indeed as any other group of muscles may remain affected. In this class of cases the deformity is for the most part very severe: the

arches of the feet are reversed, and the sole is convex towards the ground.

*Traumatic valgus.*—The worst form of traumatic valgus that I remember to have witnessed came under my care in St. George's Hospital. It occurred after extensive ulceration on the dorsum of the foot, the result of a burn, and was occasioned by cicatrisation in healing. The illustrations (Figs. 38 and 39) show how completely the arches of the foot

FIG. 38.

were reversed, and how the foot was flexed and everted. The outer margin of the foot also was raised, and the tendo Achillis was tense; so that there was scarcely perceptible motion at the ankle-joint.

Valgus, again, results from disease of the ankle-joint itself. It is not common, however, and when it occurs the lesser affection is lost in the greater. No one would treat eversion of the foot, when there

existed at the same time disease of the ankle-joint; except in so much that it might, and probably would, be necessary to support the foot on account of the disease in the articulation. Malposition, consequent upon disease, may, however, require to be removed: the peronei may remain retracted, and the foot in consequence everted; or there may be, in addition, partial ankylosis of the ankle-joint.

And, lastly, inflammation about the foot and

FIG. 39.

ankle, by inducing softening of the ligaments, or by suppuration and loss of substance, may induce a form of valgus which is obstinate and difficult to treat.

*Treatment.*—The treatment of congenital talipes valgus varies as the amount of deformity varies. Thus, slight cases of valgus are occasionally met with, just as slight cases of inversion of the foot are

also sometimes seen, which require no other treatment than simply the application of a bandage, to bring the foot gently into its normal position.

When the tendons are rigid—indeed, in all severe cases of congenital valgus, and in all ordinary cases—it is necessary to divide the retracted tendons. Whenever tenotomy is necessary in valgus, the peronei tendons require division. In a somewhat increased grade of distortion the extensor longus digitorum will also require division. The distortion should then be reduced to a condition of equinus; and eversion having been slowly and gently, but entirely overcome, the tendo Achillis, when the gastrocnemius is tense, should be divided. The foot should then be flexed upon the leg until the natural position of the limb is gradually restored. The peronei tendons may be divided at one inch above the external malleolus, and the extensor longus and peroneus tertius as they pass over the tibio-tarsal joint.

The *treatment of non-congenital valgus* varies according to the degree of deformity and also as the cause which gave rise to deformity.

A large majority of cases of valgus depends on general and local debility, and in these the form of the foot is restored by local support and rest of the limb when the deformity is not severe. In these cases the general health always requires attention. Such patients are usually overworked and under-fed, or they are wrongly fed. In many young people with lax fibre, a well-made boot with a spring in the sole, is all the local treatment that is necessary. But when

the distortion is of long standing, and structural shortening has taken place, it will be necessary to divide the peronei tendons, as well, perhaps, as the tendo Achillis. In paralytic valgus it is seldom necessary to divide tendons, except it be, perhaps, the tendo Achillis. And it is never necessary in rachitic valgus to divide any tendons. In rachitic valgus the tarsal bones undergo some change in form. The treatment in these cases is that which I have already recommended as the treatment of rickets, with that for talipes valgus superadded.

Spasmodic valgus being, as has been already explained, a sequel of convulsive action, it is necessary, after the subsidence of irritation and when the epileptiform condition, or analogous state, has been removed, to divide the retracted tendons and restore the shape of the limb. There is often superadded contraction of other muscles than those of the foot only, the upper extremity frequently being also affected as well as the muscles of the thigh (especially those of the internal and the posterior femoral regions); but in the foot it becomes necessary to divide the extensor longus digitorum, in addition to those other tendons which have been already mentioned.

The mechanical treatment of this, as of every other deformity, should be carried on gently and without violence, so that the integument may not be injured. The treatment in many cases is tedious; but force is not necessary: the structures will yield to slow and continued extension.

Allusion has been made above to a compound ·ariety of talipes valgus, which is known as *equino-lgus.* This term is applied where there is some-

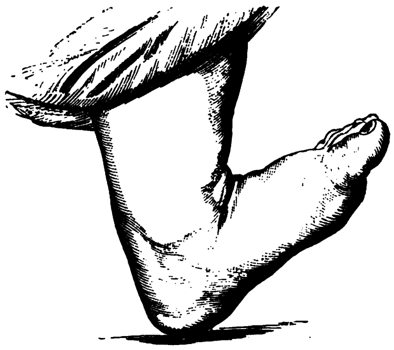
what more elevation of the heel, through contraction of the muscles of the calf of the leg, than is found to exist in an ordinary case of valgus (see Fig. 20, p. 63). In every other respect the distortion is similar to that which has just been considered. It is unnecessary, therefore, to make separate mention of the variety, except that, without this explanation, the name might cause confusion.

# CHAPTER VII.

## TALIPES CALCANEUS.

THE essential characteristic of talipes calcaneus, whether congenital or non-congenital, is depression of the heel. In congenital calcaneus the dorsum of the foot is brought more or less into contact with the anterior surface of the leg; and it is retained in this position by retraction of the flexor muscles of the foot. In this respect, therefore, talipes calcaneus is the reverse of talipes equinus. This is shown in Figs. 40 and 41.

FIG. 40.



In Fig. 41 there is calcaneus of one foot, and varus of the other.

Congenital calcaneus is the least important of the several varieties of talipes; for the distortion is

easily removed by manipulation and bandaging only. And should the deformity not have been removed before the child begins to walk, the muscles of the calf of the leg, which extend the foot, rapidly overcome this abnormal action of the flexors. Cases are, however, occasionally seen in which structural

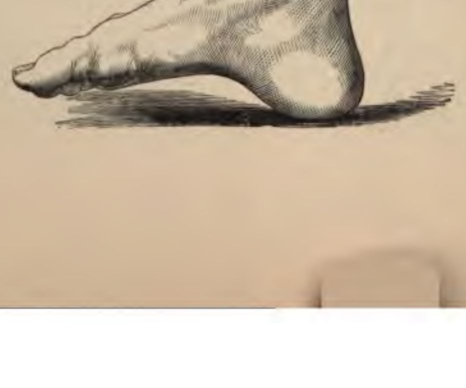
FIG. 41.

shortening of the flexor muscles has taken place, and where, consequently, operative proceedings are necessary to restore speedily the normal position of the foot. In these rare cases the tendons of the flexor muscles require to be divided as they pass over the ankle-joint. The foot should then be supported on a well-padded, flexible splint; and, at the expiration of a week, slight, gradual extension, as in the other forms of talipes, is to be made until the normal position of the foot is obtained.

## NON-CONGENITAL TALIPES CALCANEUS.

Non-congenital talipes calcaneus is usually of paralytic origin: the heel drops through paralysis of the muscles of the calf of the leg. Here, therefore, as in congenital calcaneus, the heel first touches the ground in walking. The principal changes to be observed, then, in this form of talipes are depression of the os calcis, elevation of the anterior portion of the foot through retraction of the flexor muscles of the foot, and shortening of the plantar fascia; through which the sole becomes deeply arched, and the heel and the ball of the great toe become further approximated. (See Figs. 42, 43, and 44, which show different degrees of the distortion.) In this deformity, especially when it arises from

Fig. 42.



paralysis, the muscles of the calf of the leg undergo wasting and fatty degeneration. And, when the distortion is of long standing, not only are the muscles of the calf of the leg attenuated, but all the

FIG. 43.

muscles of the leg will have passed into a state, more or less, of fatty degeneration. Figure 44 is taken from the most severe instance of deformity of

this kind that I remember to have seen. Here both heels were equally affected.

FIG. 44.

*Treatment.*—It is seldom necessary, in the treatment of this affection, to divide the flexor tendons. The plantar fascia, however, generally requires division, and subsequently mechanical treatment will improve the shape of the limb. If, however, these cases are seen soon after distortion has arisen, not only may much deformity be prevented by the adaptation of mechanical means, but it is probable that muscular power may be in part or even wholly restored by means of stimulating applications, warmth, and galvanism. Unfortunately, however, these deformities often are not seen until much time has elapsed—when loss of power is probably to a great extent permanent. An elastic band may with great advantage be affixed to the heel of the boot, and

above to the calf-plate of the leg support: it is the best substitute we have to offer for the active muscle.

Of *calcaneo-varus* and *calcaneo-valgus* I have to speak much in the same manner as I have already spoken of equino-valgus—namely, that they do not deserve separate mention. In the former, together with depression of the heel, there is also slight inversion of the foot; while in the latter there is depression of the heel and slight eversion of the foot.

*Disease of the ankle-joint may give rise to various deformities.*—It has already been said that valgus may result from disease of the ankle-joint. Flat-foot arising from this cause is not a direct result of disease, however, but it is consequent on the position of the limb. Again, when the joint becomes inflamed, the foot remains slightly extended upon the leg; or the foot, being supported, is maintained either at a right angle with the leg, or perhaps at an acute angle. Hence there may result, as a consequence of inflammation of the ankle-joint, either equinus or calcaneus, or rectangular contraction. The mobility of the joint may be destroyed by true ankylosis, or it may be impaired by false ankylosis; or, again, cicatrices and adhesions may induce muscular retraction and articular rigidity.

And I may mention here that disease of some of the tarsal bones, especially the astragalus and the os calcis, not unfrequently occasions muscular retraction and articular rigidity. I lately had an interesting example of this form of irritation under my care at St. George's Hospital, where a

portion of the os calcis had become necrosed, and irritation had given rise to retraction of the muscles of the calf of the leg, so that the ankle-joint was held immovably fixed, and the heel was raised fully one inch from the ground. I removed the diseased bone, and the wound soon afterwards healed. The heel remained raised, however; so I divided the tendo Achillis, and after union was complete the motions of the joint were perfectly restored. This case was immediately followed by two others of a precisely similar character, not in the hospital, however; and in each case the result was equally satisfactory. In each instance the primary inflammation was excited by an accident; such as a kick, falling down stairs, and falling from an inconsiderable height and at the same time twisting the ankle. In each of these instances the child was a dark-haired girl: one was a Jewess.

*Treatment.*—The treatment of distortion arising from disease of the ankle-joint involves the treatment of ankylosis; so to avoid repetition, I will reserve what I have to say on this subject for the present. Where muscular retraction exists, giving rise to rigidity of the joint, with or without soft adhesions, it is necessary to divide the tendons of the retracted muscles, and gradually to restore the position of the foot in its relation to the leg by means of Scarpa's shoe or some similar form of instrument. And thus, where the muscles of the calf of the leg are retracted, causing the heel to be raised, the tendo Achillis should be divided; but where the heel is depressed, the flexor muscles, especially the extensor longus digitorum, and perhaps the tibialis anticus and the

extensor proprius pollicis, will require to be divided. Where the contraction is rectangular, it may be sufficient alone to divide the Achilles tendon. In all cases, however, of rectangular contraction with false ankylosis, where the adhesions require to be ruptured, it is necessary to divide both the extensor and the flexor tendons, or those of them which appear to be retracted and are likely to offer themselves as impediments to the free motion of the joint, before the adhesions are ruptured. Mary C—, lately a patient at St. George's Hospital, is a good illustration of this operation. She was admitted with false ankylosis of the ankle- and knee-joints. The rigid tendons around the ankle-joint were divided subcutaneously, and subsequently the adhesions were ruptured, after the administration of chloroform. The knee was operated on later. Perfect motion was obtained, both in the knee and in the ankle-joints.

## CHAPTER VIII.

### CONTRACTIONS OF THE LEG AND THIGH.

CONGENITAL contractions of the leg, equally as those of the thigh, are rare; yet there are occasionally found, together with congenital distortions of the feet, retraction of the flexor muscles of the leg, as well as of the thigh. Usually both limbs are together affected, and in a similar manner, as was the case in the example which is represented in Fig. 45. In this

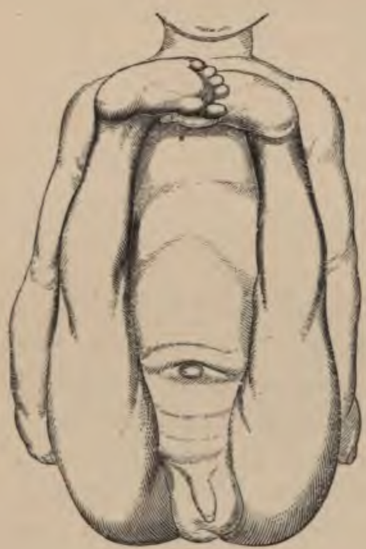
FIG. 45.

instance there was double talipes varus and both knees were contracted at right angles. But although

it is the rule that both knees or both hips shall be contracted, exceptions occur; so that one foot and leg may alone be affected, while the other is in a perfectly normal and well-developed condition.

Again, the flexor muscles of the thigh may be so contracted that the lower limbs shall be laid flat upon the trunk, while the feet, which will probably be affected with a severe form of talipes varus, will probably be crossed below the chin. This deformity is well represented in Fig. 46. Not only are the

FIG. 46.



flexors of the thighs and the adductors and extensors of the feet in these cases retracted, but the extensors of the legs are also affected, so that the knees remain stiff and immovable. I have never seen or heard of a case of equal severity with that

from which the drawing was taken, and for which I am indebted to Mr. Pick. Slighter cases have come under my care, and in these also, as in the case above mentioned, there has been talipes varus and retraction of the extensors of the legs.

## NON-CONGENITAL CONTRACTIONS OF THE LEG AND THIGH.

It has already been stated that these contractions are occasioned by spastic rigidity through spinal irritation; that they arise from injury to a portion of the nervous system through which paralysis is induced; or that they result from inflammation of the structures which enter into the formation of the limb by which muscular retraction through irritation is occasioned or otherwise that contraction is induced by inflammatory adhesion. Thus there are three pathological conditions which especially demand attention when treating of contractions of the limbs—namely, spastic rigidity, paralysis, and the result of local inflammation.

The muscles of the lower limbs which are especially affected with spastic rigidity are the flexors and the adductors of the thighs, the flexors of the legs, and the extensors of the feet. Cases are, however, occasionally met with—such as that to which I have already alluded, and which is portrayed in Fig. 5, p. 11—where not only a limb, but the entire trunk and extremities appear to be permanently affected with rigid spasm. The cast, which was taken after death, shows how unchangeably the limbs were fixed in their distorted positions. Every limb was more or less contracted, whether the upper or the lower extremities; and

not the limbs only, but the trunk also. The spine was curved as it is rare to see a spine curved; and, further, there was wry-neck and strabismus. Less severe cases than this are, of course, more common; and it is not uncommon to find in young children spastic contraction of the adductors of the thighs, with slight flexion of the thighs and legs, and extension of the feet. Such children also suffer from weakness of the muscles of the back and neck; so that the head rolls from side to side, or falls backwards or forwards, and they cannot sit or stand upright. The hands also are wanting in power. Perhaps, however, the slightest and most frequent form in which this affection presents itself is slight talipes equinus or equino-varus, together with weakness of the fingers of the same side.

It is a much more common occurrence to see contraction of a limb as a result of local inflammation than as a consequence of the causes above mentioned. No period of life is exempt from inflammation of the joints, and there are many varieties of articular inflammation; but the liability to suffer from these several varieties is not alike at all ages. Thus, childhood is particularly obnoxious to strumous diseases; but primary synovial inflammations are comparatively rare at this period. In the adult, however, inflammation of the synovial membranes is the rule. No joint occasions more trouble than the knee when it becomes inflamed; it is less painful than the hip, its capsule being less resisting; but, on account of its large and complicated synovial surface, it is more liable to inflammatory action than any other joint, and the

effects of inflammation are very frequently disastrous. The synovial secretion is poured out in increased quantity, and is of a more aqueous quality than in health, causing great distension of the capsule, and extension of the ligaments of the joint. The limb is at this time flexed; for this position allows of the greatest amount of distension of a joint with the least pain. The ligaments become softened and extended; and as the fluid in the joint is absorbed, the head of the tibia undergoes displacement backwards. This was the course of the disease in the case of Brewster M—, who was lately a patient in St. George's Hospital. He was admitted with a contracted knee, the result of inflammation about the joint. Abscess had formed, and a portion of the head of the tibia was necrosed. This portion of bone was lying loose in the ham, and having been removed, the wound closed. The flexor tendons were then divided; the leg was gradually extended and the head of the tibia restored to its normal position, or nearly its normal position.

Occasionally, contraction of the flexor muscles of the leg causes excruciating pain, and especially this is the case when there is commencing ulceration. Some years since I saw, together with Sir Benjamin Brodie and Dr. Metcalfe Babington, such a case. I allude to it, for I never before or since saw an instance of such powerful contraction of the flexors of the leg, attended with such acute pain. Pain was incessant, and it was so severe that this patient was anxious to lose his limb. Every night he swallowed half an ounce of tincture of opium at a dose, and even that quantity frequently failed to procure

sleep, and it never secured for him more than one hour's rest. It was determined in consultation to divide the flexors, and gradually to extend the limb. So soon as the tendons were divided, pain ceased; and in the course of half an hour our patient was asleep, and this without the help of opium. There was no recurrence of pain. In the course of six weeks or two months he began again to use his leg.

The following case was lately in the Grosvenor Ward, of St. George's Hospital. In this instance the limb was contracted and very painful, and the pain entirely ceased on dividing the tendon of the semitendinosus muscle. The following description is written by the patient himself:

R. J. G—, æt. 30, was admitted into St. George's Hospital, May 4th, 1870, with disease of the right knee-joint. He says, "I had an attack of acute rheumatism about nine years ago, and since that time have been subject to occasional rheumatic pains in various joints, especially in the right knee. About twelve months after the first attack I noticed a small swelling, about the size of a nut, of an elastic character, at the outer side of the knee. It disappeared after some four or five months, and was followed by slight effusion into the joint. This was so slight at first as to be scarcely perceptible; but with every attack of cold the tenderness and swelling increased in and around the joint. After three or four years the joint became tender to the touch at all times, and motion more and more imperfect. I continued at my duties, and was accustomed to much walking and standing many hours daily. The joint was always more swollen and tender after the day's exercise. I consulted a surgeon, who prescribed a blister over the entire front of the knee, and cinchona with hydrarg. perchlor. internally. The medicine disagreed with the stomach, and the blister was severely felt, and set up a good deal of inflammation around the joint, after the subsidence of which it felt no better. I continued to go about actively from that time, still being subject to rheumatic

pains; and the knee becoming gradually more swollen, motion more limited, and tenderness increasing. I was in the habit of taking anti-rheumatic medicines, and applying counter-irritants —tincture of iodine, &c.—to the joint, but never gave up my duties, or took a day's rest. I always felt, otherwise, in good health. In addition to my ordinary duties, about two years ago, I applied myself closely to study; and at this time the knee became more swollen and flexed, and motion more limited. In July, 1869, while I was walking, I suddenly felt a severe pain, as though confined to a spot about the size of a sixpence, in the interior of the joint. This spot has, since that time, always continued painful, and caused me when walking or standing to bring the muscles on the inner side of the thigh into unwonted action. This pain was quickly followed by a fluctuating swelling about the size of a pigeon's egg at the inner and inferior part of the thigh, immediately above the condyle of the femur. I still continued to go about, but was compelled to use two walking-sticks. On January 15th, 1870, I applied to Mr. Brodhurst. The joint was then greatly enlarged by effusion into, and swelling all around it, and the lump above the inner side was as large as a hen's egg. I was ordered steel and cod-liver oil; to go on crutches, not to use the leg, but to carry it in a sling. A padded metal splint was applied to the back of the joint; counter-irritation was kept up for a few months, and continuous pressure by means of bandages. The swelling and effusion diminished somewhat, but the joint was becoming much deformed by displacement of the bones of the leg outwards and backwards. On admission into the hospital there was severe and continual pain along the internal and anterior part of the head of the tibia, with increasing tension of the hamstrings: the limb was more flexed, and displacement was increasing. There was also detected considerable roughness in the interior of the joint on motion. The day after admission Mr. Brodhurst divided the semi-tendinosus tendon. This operation gave me instantaneous relief from all the severe pain around the head of the tibia. The limb was kept in splints for a few days, until the puncture was quite healed, when it was placed in an instrument, by means of which the limb was gradually extended to its normal shape. The effused fluid became absorbed, and, after a few months, the joint diminished to its normal size. In August last I had a severe attack of rheumatic

fever, which weakened me very much, and retarded my recovery. There is now (October 3rd) good motion in the joint, and there is no roughness to be felt."

*Congenital contractions of the toes* are sometimes hereditary. I know a family in which for three generations every member has been born with contraction of the second toe of each foot. Contraction occurs much more frequently, however, as a non-congenital affection, and for the most part through wearing tight boots. From this cause one or more toes may be contracted, or even they may be doubled under the sole of the foot, and be almost hidden from view.

## CHAPTER IX.

### CONTRACTIONS OF THE UPPER EXTREMITY.

In the same manner as has been already described, there is also found flexion of the forearm upon the arm, through retraction of the biceps and the brachialis anticus muscles ; of the wrist, through retraction of the flexores carpi; and of the fingers, through retraction of their flexors. But of all the various forms of contraction of the upper extremity, none are more interesting and of more frequent occurrence than those of the hand.

*Congenital contractions of the fingers and hand* are occasioned by thickening and a contracted condition of those portions of the palmar fascia which pass to the first and second phalanges, and which are attached to the ligaments of the articulation between these phalanges. The little finger is very commonly alone contracted. This may seem to be only a trifling affection : it occasions, however, considerable inconvenience; for the fingers cannot be fully expanded, and, consequently, among other things, the performance of instrumental music is seriously interfered with. Occasionally, however, cases are met with where not only accomplishments are interfered with, but where the fingers are so much contracted that the ordinary avocations of life cannot be fulfilled.

Such was the case with a girl lately in St. George's Hospital, in whom all the fingers of both hands were more or less affected. The second phalanx was, in this instance, bent upon the first, as is shown in Fig. 47. This was a congenital affection; and it

Fig. 47.

rendered this patient so helpless that she could not gain her livelihood. In this instance there was more or less contraction of all the soft structures, as well as of the flexor muscles themselves.

## NON-CONGENITAL CONTRACTIONS OF THE FINGERS AND HAND.

Non-congenital contractions arise, for the most part, in a gouty or a rheumatic diathesis, and especially where spirituous liquors are habitually taken in considerable quantities. There is, however, always some present exciting cause to induce contraction—some local irritation, together, perhaps, with exposure to cold and damp. The cabman's whip and reins, for instance, appear to act frequently as causes of this common form of contraction. It may also be produced by handling a sword, by wearing a ring, or by pressure in the palm of the hand, such as is produced by the carpenter's saw or the jeweller's tool, or by leaning heavily on a stick or a crutch. In these cases the fascia in the palm of the hand undergoes chronic thickening. It is a painless affection, and its course is very slow. Contraction, for the most part, commences in that portion of the fascia which passes to the little finger, and this finger becomes somewhat thickened, and then slightly flexed into the palm; and subsequently the ring, middle, and index fingers, and very rarely also the thumb, become more or less drawn down towards the palm, and they cannot be extended. The appearance which this affection presents is well shown in Fig. 48. The process of fascia which passes to each contracted finger becomes more

and more dense as the finger becomes more contracted; and occasionally instances are seen where the fingers are so firmly closed that it is difficult to introduce the knife beneath the band of fascia, and even cases are not rare where the pressure of the nail may even excoriate the palm of the hand.

FIG. 48.

*Treatment.*—The treatment of these several affections varies as the pathological condition varies. Thus, as has been been already explained, in spasmodic contractions, recourse can be had to section of tendons only when irritation has entirely or in great measure subsided; for contraction would necessarily recur if tendons were to be divided at an earlier period. Until this time has arrived, counter-irritants in the course of the spine may be employed, and nutrition should be promoted to the utmost. When irritation has ceased, the tendons of those muscles which remain permanently shortened may be divided. Among others, those of the flexor muscles of the leg —namely, the biceps, the semimembranosus and the semitendinosus—require to be divided, as well perhaps as the tendo Achillis. There was lately an

excellent illustration of the condition to which I am now referring in St. George's Hospital.

This child was sent up to the hospital from Blackpool by Dr. Risk, suffering from contraction of the extensors of the feet, the flexors of the thighs and legs and the adductors of the thighs. In consequence of this state of the muscles, the trunk was thrown forward, so that the child could not stand without help. The flexors of the legs and the extensors of the feet were divided, and mechanical means were employed to overcome other contractions; and after some weeks of treatment, the child was able to walk fairly in the ward with the aid of a stick. The change which was produced in the form of this child, from a crouching to an upright position, was so remarkable that it might well be doubted if its mother would recognise her child. There was also a severe form of strabismus. The internal rectus was divided by Mr. Power, and the removal of the squint tended much to improve the child's appearance.

As a result of infantile and other forms of paralysis, when structural shortening has taken place, tendons also require to be divided, as in the instance just cited. The result of operation in these cases is not, however, so favorable as in the former: more or less muscular weakness of the limb generally remains, notwithstanding the employment of galvanism, excitants, &c.; so that mechanical support is required for a lengthened period after the operation. Where spasm has occasioned contraction, mechanical support also is required to be worn for some time; but in these cases it may be discontinued, as the

muscles begin to recover power and resume their functions.

Both in spasmodic and in paralytic affections, distortion may be prevented by the timely use of adequate mechanical means. It is only, for the most part, when such means are neglected that contraction and structural shortening and deformities result.

When the flexor tendons have been divided, extension should be made slowly until it is complete.

The mode of division of the biceps tendon is as follows:—The patient, lying on his face, will endeavour slightly to bend the knee, which will cause the muscle to spring into action, and make the tendon tense. The tenotome will then be introduced beneath the tendon from the centre towards the outer side of the limb, and, being guided close to the tendon, it will pass between it and the peroneal nerve. The edge of the knife will then be directed upwards towards the tendon. So soon as the tendon is divided, the peroneal nerve becomes prominent, and a tyro may even doubt whether the tendon has really been divided. If care has been taken to pass the knife fairly and fully beneath the biceps tendon, on using a cutting motion the tendon will certainly be divided, and the knife may be felt covered only by the integument. The knife should then be withdrawn, and on no account should it be re-introduced. I have known more than one instance in which the temptation was felt so strongly to do this that the knife was re-introduced, and the nerve divided. Temporary paralysis of course followed. After the tendon has been divided the puncture should be carefully closed,

and the limb bandaged; and in the course of three or four days, when the wound has healed, extension may commence.

When contraction of the thigh, through inflammation of or around the hip-joint, or from any other cause, has taken place, it is seldom necessary to use the knife. These contractions are overcome so perfectly by means of instruments for extension, that it is superfluous for the most part to divide either muscle or other resisting structure. Occasionally, however, a band of fascia may require to be divided, or perhaps the tensor vaginæ femoris. It is rare, indeed, however, that this is necessary. I have also divided more than once the adductor longus, as well as the sartorius, which appeared to influence a limb injuriously; but I cannot recommend these operations to be undertaken, for I doubt if any advantage is to be derived from them.

Again, in contractions of the forearm, mechanical means are for the most part sufficient to overcome contraction. It is occasionally necessary, however, to divide the tendon of the biceps. When this is much contracted, it is raised considerably above the vessels, and may be divided without danger. And after the biceps tendon has been divided, the brachialis anticus, and the other contracted structures, yield readily to extension. Contractions of the wrist-joint also generally yield to mechanical means, when there is not any displacement of the bones of the carpus. When the hand is displaced backwards or forwards, it may be necessary to divide the flexor tendons before the articular surfaces can be placed in apposition.

When one or more toes are contracted in children, gentle bandaging will generally remove this deformity; but in later years, when the flexor tendon is rigid, it is necessary to divide it. In the adult, it is impossible to remove a well-marked deformity of this kind without dividing the flexor tendon. The tendon should be divided opposite to the first phalanx, and the puncture having healed, extension may be made very gradually. And in a similar manner the extensor tendon may require to be divided. This is much more rarely required, however, and when it is done extension should be made more slowly, for the resistance is less. Even now-a-days we hear constantly of proposals to amputate toes which happen to be contracted,—especially the little toe; for there is supposed to be some special difficulty in restoring the little toe to its normal position, and consequently amputation is suggested as the shortest mode of removing deformity. It should also be remembered that this short method of cure irrevocably maims the foot. I need scarcely say that the idea of amputation of a toe should not be entertained where it is not absolutely necessary. Nothing is easier than to restore the position and action of toes thus circumstanced by dividing the flexor or the extensor tendon, as the case may be, and by using subsequently gradual extension.

In contraction of the palmar fascia, mechanical extension will sometimes be sufficient to remove the distortion. In general, however, extension is exceedingly painful, and cannot be borne. Recourse should then be had to division of each contracted

portion of fascia. So soon as the punctures have healed, extension may commence, and be carried on as rapidly as it can be borne. The palm of the hand must then be fully unfolded and the fingers extended; for should any portions of fascia remain contracted, the fingers will again in time be drawn into the palm of the hand.

Fig. 49 is intended to represent that form of

FIG. 49.

contraction which is caused by chronic rheumatic inflammation of the hand.

I introduce this figure without further comment, and merely for the sake of distinction; for although there is contraction here, there is no analogy between this and the other forms of distortion which have now been described. In these there is simple contraction of the more superficial textures: sometimes the tissues external to the flexor tendons are alone affected, while in others the flexor muscles are retracted as well as the fascia and other soft tissues; but in this last-mentioned instance deformity is induced by disease of the articular surfaces.

# PART II.

# AFFECTIONS OF THE JOINTS.

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## CHAPTER X.

### ANKYLOSIS.

ANKYLOSIS is either true or false. True ankylosis, or synostosis, implies that the soft structures of the joint have been destroyed, and that bony union has taken place between the adjacent bony surfaces; and by false ankylosis is understood the formation of membranous, or fibrous adhesions within or external to a joint, and which interfere with motion.

*Fibrous ankylosis.*—False, partial, or fibrous ankylosis is induced by the deposition of lymph within or around a joint through which adhesions are formed which interfere with motion. Under these circumstances motion may be only slightly impeded, or it may be, in fact, lost. If the muscles about a joint, or the tendons which pass over the joint, can be rendered prominent, or tense, ankylosis is not complete; neither is it complete, or bony,

should the slightest motion remain. And even though motion be lost, the same sensation of solidity is not imparted to the hand on grasping the limb firmly above and below the articulation, as when bony ankylosis has taken place.

Fibrous, or false ankylosis may be divided into two classes, which may be severally designated extra-capsular and intra-capsular.

*Extra-capsular ankylosis* depends on inflammatory action, such as is induced by burns, phlegmonous erysipelas, mechanical injuries, and indeed on every form of inflammation through which lymph is deposited around a joint; while *intra-capsular ankylosis* is occasioned by various forms of inflammation which have affected the structures within the joint, and through which adhesions have been formed.

Thus, the fibrinous deposit, whether within the joint or external to the capsule, becoming organised, constitutes false ankylosis.

Lymph is poured out into the cellular tissue around a joint, and about the sheaths of the tendons and muscles in its immediate vicinity; it becomes organised, and the parts are more or less matted together and fixed, whether in an extended or a flexed position, and their functions are impaired. And when the interior of the joint is affected instead of that portion of the limb external to the capsule, then, in a somewhat similar manner, adhesions are formed between opposed surfaces; the inflammatory product becomes organised, and motion is hindered. Both in intra- and in extra-capsular inflammation the amount of injury to the limb will depend in some measure on the character of the inflammation. It

will depend much more, however, on the mode in which that inflammation has been treated; whether attentively from the commencement, with absolute rest, or negligently—allowing the use of the joint; for in proportion as the inflammation is of long duration, so in all probability will the adhesions which form be dense and extensive. In many cases the adhesions are slender, but although slender they may entirely prevent useful motion; or, again, they may be more extensive, and yet yield and allow of increased motion. When, however, disease is arrested, and the interior of the joint is restored to a healthy condition, while the articular surfaces occupy their normal positions, the adhesions which have formed may be so dealt with that motion may be restored.

There is a form of inflammation, known as gonorrhœal inflammation, which gives rise to ankylosis perhaps more frequently than any other form of inflammation in and about joints. In this form of inflammation, serum is effused into the synovial cavity to so great an extent as to produce excessive swelling and tension of the integuments. Suppuration, however, never occurs, but lymph is deposited on the synovial membranes, through which adhesions are formed between opposed surfaces.

When effusion has taken place, the limb remains in a semi-flexed position; for in this position the structures around the joint are more relaxed than in an extended condition of the limb. The effused fluid may be removed, and the joint may resume its healthy action, but more or less stiffness will remain during several weeks, and a crackling

sensation will probably be communicated to the hand on moving the limb. Notwithstanding that effusion may be very considerable, dislocation never takes place in this form of inflammation; and this fact may be said to be diagnostic of the disease, for whereas in every other form of articular inflammation, the tendency is for the articular surfaces to become displaced, in this form, where the effusion into the joint is perhaps greater than in any other form of inflammation, dislocation never occurs.

The patient having once suffered from this form of inflammation is extremely liable to a recurrence of it. The inflammatory attack will probably not be more severe on the second occasion, but the damage to the affected articulations will be greater; and one or more joints may remain ankylosed. Thus, each attack of inflammation appears to be more virulent in its character, and to leave behind it more trace of the disease than the previous one. The knee-joint is perhaps affected more frequently than any other joint; but the hip also suffers, and scarcely less frequently.

Some time ago I saw a gentleman who was serving as lieutenant in one of our regiments in a tropical climate, and who, having contracted gonorrhœa, had exposed himself to the effects of damp, by sleeping after sunset in the open air, was roused from sleep in great pain all over the body, but especially affecting one hip. The pain in the hip was excessive, and the effusion became so great that it was considered suppuration must follow. Neither, however, did suppuration take place, nor did the head of the femur become dislocated; but

false ankylosis of a very firm character resulted from this attack of gonorrhœal rheumatism.

Besides the hip-joint, both shoulders, one knee, and an ankle-joint became inflamed at the same time, but, with the exception of the hip, all the joints passed through this inflammatory condition without material injury, and at length they recovered perfectly.

Sometimes the urethral discharge seems to alternate with the articular inflammation. Thus, the urethral discharge will cease as the articular inflammation becomes developed, and it recurs as the articular inflammation subsides. I have known this alternation of inflammation to continue for several weeks, and at length ankylosis to result from it.

The first attack of gonorrhœal rheumatism, if promptly treated, may terminate in a perfect recovery, and without leaving behind it any ill effects. And a second attack may also terminate in a similarly fortunate manner, though this may be considered to be a rare piece of good fortune. But a third attack of inflammation usually leaves some unpleasant remembrances. The following is a case in point.

A gentleman wrote me a note, asking me to go to him, as he wished to consult me, but could not come to me. When I saw him, he told me the following history :—

When he was twenty-five years of age, he contracted a gonorrhœal discharge, which was followed by synovial inflammation with effusion into both knee-joints. He was confined to the house during a fortnight or three weeks, and was then again able to walk about. At this time, however, the swelling

and stiffness of the knees had not quite subsided. The urethral discharge continued for two months, and then it ceased. Before three months had elapsed, the use of the knees was perfectly restored. At this period, he again contracted a gonorrhœal discharge, and it was followed, in the course of some few days, by inflammation of the left hip-joint, of both ankle-joints, and of the tarsal joints. The swelling and stiffness lasted longer on this than on the previous occasion, and, indeed, ten months passed before he was able to walk with sticks. Stiffness continued after this time yet for many months, but at length he regained the use of the affected joints.

In November, 1852, a similar series of events occurred as before. On this occasion, however, both hip-joints became inflamed, as well as both ankle-joints and one knee-joint. The effusion and pain were greater on this than on any previous occasion, and he was longer in recovering. Indeed, he never entirely lost the stiffness about the hips, and had always difficulty in rising from a chair.

In 1854 he married. Articular inflammation returned with redoubled violence, without any urethral discharge being present, and attacked in succession every articulation in the body.

I found him with ankylosis of all the cervical vertebræ, and of most of the dorsal vertebræ, as well as of both hips. Subsequently, ankylosis took place of the temporo-maxillary articulations, the shoulder-joints, and the knees. And before death took place the entire skeleton was ankylosed: he could not even move his head.

The recurrence of this form of inflammation is sometimes very remarkable. I saw, with Dr. William Ogle, in St. George's Hospital, E. G—, aged 46, on account of considerable effusion into, and thickening about, the knee-joint. Ankylosis had taken place of the wrist-joint, the vertebræ, and the ribs. The breathing was diaphragmatic.

In the year 1855 (thirteen years prior to his second admission) he was a patient of Dr. Wilson's, in Cambridge Ward, for gonorrhœal rheumatism. Since that period he had never contracted gonorrhœa, but had at various times suffered pain in different joints, and is conscious that gradually his back and neck, as well as the wrist and knee, have become stiff.*

In many cases of partial ankylosis there is, also, partial displacement of the articular surfaces. Some of these admit of rectification of the limb. In the majority of instances, however, this amelioration can only be partially accomplished, and it cannot always be maintained even after tenotomy has been performed. It is unnecessary to say that there is no hope of restoring motion, in a permanent manner, unless the position of the limb as regards the articular surfaces is first restored.

*Treatment.*—The treatment of partial ankylosis may be divided into—1st, gradual extension with or without tenotomy; and 2nd, flexion of the limb, with or without tenotomy, and subsequent gradual extension.

* For further information on this subject, I must refer to the article on "Gonorrhœal Rheumatism," in Dr. Russell Reynolds's 'System of Medicine,' 2nd ed., 1870.

In all cases of partial ankylosis there exists some muscular rigidity; in some cases, also, cicatrices are found, resulting from loss of substance. Where adhesions are recent, contraction of a limb may probably be overcome by continued extension—such extension, namely, as is made by means of a well-adjusted instrument for the purpose; but, except in cases of recent adhesions, it is generally necessary to commence the treatment by dividing the tendons of rigid muscles, and by dividing, subcutaneously, cicatrices. It is better to proceed at once to these subcutaneous sections rather than to prolong the treatment by extension unnecessarily; for, without the adhesions are recent, simple extension is seldom of itself and uncombined with subcutaneous sections sufficient to remove the contracted condition of a limb. It is important to remember this principle of treatment, for partial displacement of the articular surfaces is easily induced by continued extension of the limb if the tendons have not been previously divided. Indeed, it is not uncommon to see this displacement take place at the knee when extension is long continued and where the tendons have not been divided. Whenever, therefore, it is desired to remove contraction, it is the rule first to divide the tendons of rigid muscles and to divide cicatrices subcutaneously, and subsequently to proceed gradually to extend the limb.

But if such be the law of treatment where the articular surfaces occupy their normal positions, it is even more to be insisted on when any displacement has taken place. Extension should then without fail be preceded by the subcutaneous section of such

tendons, fasciæ, and cicatrices as might interfere with the re-adjustment of the articular surfaces.

These obstacles to extension then having been removed, a well-adapted instrument is to be applied to the limb, and extension is to be made slowly. The instrument should support the limb efficiently; and it should always, in the first instance, be applied at that angle, whatever it may be, at which the limb was held before the subcutaneous sections were made. So soon, then, as the punctures have healed, extension may commence and be carried on gradually without producing pain and without occasioning displacement.

Numberless cases, however, exist in which the means above mentioned are useless to restore to the limb either the normal position of its parts or to restore motion; cases, for instance, in which the adhesions are so firm that they do not yield to gradual extension. The pressure produced by continued extension may occasion destruction of the integument, or it may induce displacements, partial or complete, of the articular surfaces; but the adhesions, whether intra- or extra-capsular, will not yield to such force. Injury alone, but no useful result, can accrue from gradual extension in these cases. Before chloroform was introduced, these were among the *opprobria* of surgery. Then, gradual extension of such limbs was continued for months and years without any advantage being derived.

Thus, it is necessary, before proceeding to the treatment of a case of this kind, to form a correct diagnosis—to determine whether complete ankylosis has taken place or whether the adhesions are

fibrous; and if fibrous, whether they will or will not yield to gradual extension. If these several points cannot be otherwise determined, chloroform should be fully administered, so that when muscular relaxation has been obtained, both the character of the adhesions and the amount of motion may be ascertained.

When bony union has taken place, a sense of solidity and continuity of structure is communicated to the hands on grasping the limb above and below the articulation; but when fibrous adhesions have formed, either slight motion may be felt at the articulation, or at least a sense of elasticity is communicated, on endeavouring to flex the limb. And if the adhesions are of such a character—so firm and unyielding—that the normal position of the limb can only be gained by force suddenly applied to rupture the adhesions, the force should be so applied that it is used mainly, if not entirely, in flexion of the limb.

Instances of this kind are mentioned by Meckren, Bartholin, and Amussat. The latter communicated an instance to the Académie de Médecine, in 1831, in which forcible flexion had been performed. But the operation may be said to have been instituted by Louvrier, whose attention had been called to cases of this description. He was successful in the first five cases which came under his care. Then he came to Paris, and, not being able to distinguish between true and false ankylosis, accepted every case of the kind for operation which presented itself in the hospitals. Here he was as unsuccessful as he had been previously successful.

Palasciano, with more pathological knowledge than

Louvrier, followed in his footsteps, and with more success; and having again directed attention to the operation, it was practised especially in Lyons, Berlin, and Vienna, by Bonnet, Buehring, Berend, Schuh, Lorinser, and others.

As practised at that time, and before chloroform was recognised in surgery, this was a terrible operation. Dieffenbach was among the first to modify the operation. He first divided contracted tendons subcutaneously, and then immediately ruptured the adhesions. In many instances the wounds were made to gape and extend into lacerations.

Langenbeck also saw in this operation a means of restoring power to a crippled limb; and, availing himself of the inhalation of æther, he thought it was unnecessary to divide the tendons of contracted muscles; and he therefore divided the fasciæ only, and then ruptured the adhesions. But, notwithstanding the advantage which the anæsthetic agent gave him, his operations were not so successful as were those of Dieffenbach: displacements more or less complete were frequently produced.

It was only when tenotomy and anæsthesia were combined that the operation of forcible flexion could be looked upon as free from danger. I have performed upwards of 260 operations of this nature, and have never known any *contretemps* whatever—neither fracture, nor dislocation, nor pyæmia, nor inflammation.

Professor Bauer says, "About 600 cases of affection—contraction and ankylosis—of the knee-joint have given me ample opportunity for most thorough clinical observation, and entitle me to participate in

the important question which is still being discussed before the highest scientific tribunals of Europe. On the feasibility of forcible rupture of adhesions all are agreed. Its superiority over gradual extension can no more be questioned; and its former opponents have been effectually silenced by the overwhelming results which have been produced."*

Any tendons which are rigid should first be divided, and the punctures having healed and chloroform having been fully administered, the limb to be operated on should be so firmly fixed that all motion is prevented, except that which the operator is about to impart to the limb. Thus, for instance, if the hip-joint is to be operated on, the pelvis must be fixed; if the knee, the thigh must be securely held; and so on. When the limbs are thus firmly secured, the adhesions are to be instantaneously ruptured, by force applied in the direction of flexion. I say that the adhesions are instantaneously ruptured, when the patient is properly prepared, and the force is rightly adjusted. The limb is then to be bandaged, and especially the affected joint is to be firmly bandaged and confined either in a gutta-percha splint or on a flexible splint.

I know of no danger whatever from the use of force so applied. Indeed, when the influence of the muscles is perfectly removed, the adhesions themselves usually offer very little resistance; and if the power to be applied is sufficient for the purpose, the result is instantaneous. In a small number of instances, the hand alone is insufficient to rupture the adhesions readily; and in these I make use

* Op. cit., p. 113.

of an instrument to flex the limb. Not only is there no danger connected with this operation, but with moderate care it would seem to be impossible to set up unhealthy action. It is sometimes said that in these operations fracture is not uncommon, and that inflammation is not unfrequently excited. Let it be sufficient for me to say that I have never seen a fracture produced, nor have I known inflammation to occur, nor any other ill whatever to follow an operation of this nature; and that when disaster ensues it is from abuse of the operation. I cannot tell what might be the result of adopting such instructions as the following, which I copy from one of the latest works on the subject. After describing the preliminaries of the operation, the author proceeds thus: "A cracking noise is heard, which becomes more and more evident as the movements are continued, and at the end, it may be, of *half an hour*, the adhesions may have so far given way as to allow of motion in all directions to a very considerable extent, in a joint which had appeared completely ankylosed." This, however, is not the manner in which this operation ought to be performed. Doubtless this operation is capable of abuse, just as is any other operation; but when it is performed as I have endeavoured to describe it, I do not know an operation more successful than this is in the whole range of surgery, nor one more free from danger.

When the joint retains its normal external form, the adhesions are easily broken down by the hand, after the limb has been properly placed in position and the full effect of chloroform has been obtained.

There was lately a case under my care in the hospital, where the patient having suffered from rheumatic inflammation was admitted with partial ankylosis of the knee and of the ankle. The tendo Achillis was, in the first instance, divided, and after the puncture had healed, the adhesions were ruptured by flexing the foot upon the leg. On a subsequent occasion the hamstrings were divided subcutaneously, and, the punctures having healed, the adhesions at the knee-joint were ruptured by flexing the leg upon the thigh. This patient walked well when she left the hospital, and without lameness; and the movements at the knee and ankle-joints of the affected limb were as free as those of the sound limb.

It is a point to remember that, after dividing the tendons and before the punctures have healed, the adhesions should not be ruptured; or they should be ruptured only with great care, lest the puncture should be extended into a rent. This extension of the punctnre is much easier to effect than might be supposed, and it is, therefore, safer to allow the punctures to heal before any force is employed.

When the position of the limb is perfectly restored, then passive motion should commence. At first it may be necessary to administer chloroform, for motion is painful; but, as motion increases, passive movements excite less pain.

The notes of the following cases of the knee and the elbow were kindly supplied to me by Mr. Walker.

A. B—, æt. 12. Was admitted November 2nd, 1869, into the Grosvenor ward, of St. George's Hospital. A year and a half ago he fell down and severely injured (he says dislocated) his elbow.

He was brought to the hospital, and the arm was placed in an angular splint. He attended as an out-patient for two months, during which time he wore the splint.

In September, 1869, it was noticed that the arm was contracted. This contraction increased until the arm became flexed at an acute angle and so fixed. In this condition he was admitted as an in-patient under Mr. Brodhurst.

On the 7th of December it was found that ankylosis of the left elbow had taken place, and the adhesions were so firm that there was no movement at the joint. Chloroform was administered, and the adhesions, which were firm, were ruptured. The limb was placed on an angular splint, and so it was left for four days. The splint was then removed, but the bandage around the joint was allowed to remain. As there was some tenderness still about the joint, it was kept quiet for a few days longer, when the splint was taken off, and passive motion and friction were employed.

On the 24th of December he was made an out-patient, and in the course of six weeks had regained completely the motion of the limb; and although the power of the limb was not so great as the other arm, the extent of motion was alike in both.

September 19th, 1870.—Has perfect motion in the joint, and can use the two arms alike.

J. G—, æt. 22, valet. Admitted into the Grosvenor ward of St. George's Hospital, May 11th, 1870, for ankylosis of the left knee. Six months ago, whilst with his master in America, he fell from a bicycle, whereby he gave his knee a slight twist. He felt very little pain at the time, and was not obliged to keep his bed. Six weeks after the accident, having returned to England, he contracted gonorrhœa. Some days after this his knee suddenly became painful and swollen, and he was compelled to keep his bed. At the same time the gonorrhœa ceased. He was admitted into the hospital on December 11th, under the care of Mr. Henry Lee, and under treatment the inflammation gradually subsided; but there was left fibrous ankylosis of the joint with immobility. He was again admitted in May, under Mr. Brodhurst, that it might be ascertained if some amount of motion could be restored to the joint.

May 13th.—The adhesions, which were very dense, were broken

down under chloroform. A splint was applied, and scarcely any pain was felt after the operation.

This operation was followed by a considerable amount of motion.

June 23rd.—He was again put under the influence of chloroform, when the joint was again moved and other adhesions were broken down. Passive motion and friction were subsequently used, and in September he was discharged, having gained power to bend the knee at a right angle and to straighten the leg perfectly.

Dr. Lloyd has kindly sent me the following notes of a case of ankylosis of the hip on which I operated with him. The foregoing and the following are instructive cases, and perhaps show every point of practice as clearly as the recital of fifty cases would teach.

F. P—, æt. 37. Had in 1854 an attack of gonorrhœa, which was cured in about six weeks. In the following year he had an attack of rheumatism (gonorrhœal) in the right knee. The inflammation was attended with very acute pain and much swelling in that joint. No other articulation was affected. He kept his bed for two months during this illness, and it was several months before he was able to follow his employment. Having recovered he remained in good health for six years; but in the year 1861 rheumatism of a subacute character attacked his right hip, and it became stiff in the year 1863. At this time he again suffered from gonorrhœa, which was acute, and lasted for four or five weeks. Before the gonorrhœa had quite left him the rheumatism in the hip became very acute, and the joint remained painful for twelve months, during which time he was confined to his bed or sofa. Ankylosis and contraction of the limb resulted from this attack, and he also at this time suffered from considerable general debility.

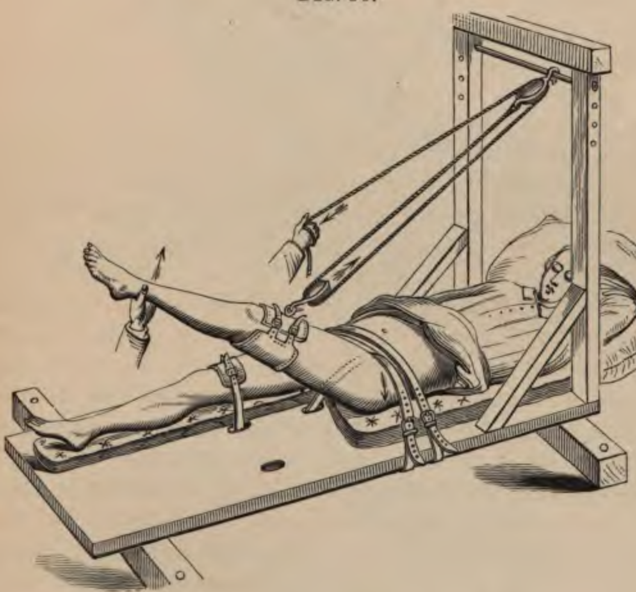
Between the years 1863 and 1869 the only treatment to which he was subjected consisted in the use of hot and cold baths, but, on going to St. Petersburg, in 1869, he consulted Bokoff, who told him that he was suffering from disease of the spine; cold baths and electricity were ordered for him with benefit to his general health.

In August, 1870, he consulted Dr. Lloyd, who found that ankylosis of the right hip-joint had taken place. Dr. Lloyd at once consulted with Mr. Brodhurst, and it was agreed that an attempt should be made to break down the adhesions under the influence of chloroform, which was done by Mr. Brodhurst, on the 15th of August.

The adhesions were instantly broken through, and the entire motion of the hip-joint was obtained. Only slight pain followed the operation. In two days the splint, which was applied immediately after the operation, was removed, and passive motion commenced. The patient in the course of a fortnight was able to plant his foot firmly on the ground, and rest considerable weight upon it. From that time the increase of motion and strength were rapid.

The following figure gives a good idea of the

FIG. 50.



apparatus which was used in the last mentioned

case. It shows how the pelvis is fixed and how the forces are directed.

In the following case, from which Fig. 51 was taken, unlike those which have gone before, the articular surfaces did not retain their normal positions; but the leg-bones were in part displaced backwards.

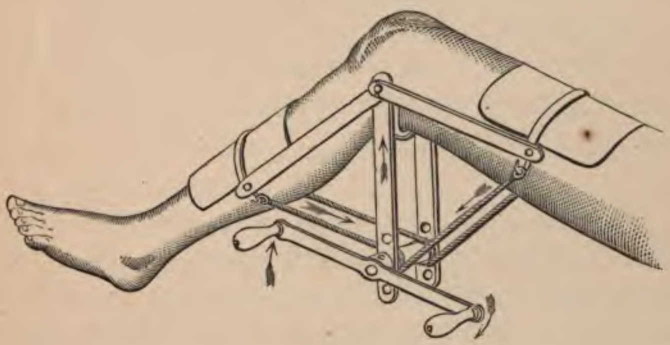
A. H—, twenty-three years of age, had suffered from abscesses about the knee for several years. Both the thigh and leg were

Fig. 51.

much scarred with abscesses which had formed and broken. Portions of the femur had been exfoliated, and a part of the tibia

was exposed when I first saw him. There was no appreciable motion at the knee-joint, and the tibia was displaced backwards. The limb was useless for walking: no weight could be borne upon it, so that crutches were always used. I was asked to break down the adhesions. This I declined to do, and advised that resection should rather be thought of; but this advice was not acceptable. Three days later this same patient again presented himself, and importuned me to attempt to straighten his limb; and at length it was arranged that an examination under chloroform should be made. Eventually the hamstrings were divided, and an instrument was adjusted to the thigh and the leg, consisting of metallic splints, which were connected with a roller in the popliteal space by means of catgut cords, and which, acting on the principle of the wheel and axle, when moved, approximated the roller and splints, and thus the knee was bent. Fig. 52 gives a good notion of this instrument.*

FIG. 52.



I applied the instrument with much misgiving; but, having tightened the cords and applied pressure, the adhesions gave way in an instant with a loud snap. The instrument was immediately disengaged, and the limb was bandaged and supported with splints.

* I am indebted to Mr. Gumpel for this apparatus and for the drawings both for this figure and also for that on page 139. And for the apparatus for ankylosis of the hip, Fig. 50, I am indebted to Mr. Bigg.

Opium was administered, and its effect was continued more or less for three days. At the end of a week gradual extension was commenced, for there was no inflammation after this operation, and thus the leg-bones were replaced, and the length of the limb restored; so that before he left London my patient walked about his room without a stick.

This operation of rupture of fibrous adhesions is usually spoken of as forcible extension of the limb; and the term is consequently not unfrequently misunderstood and the force is misapplied; so that, instead of flexing a limb, attempts are made to extend it. This mode of treatment is entirely a misconception of the idea intended to be conveyed, and, when practised, is likely to lead to mischief. Indeed, such an application of force can scarcely fail to produce lacerations and consequent suppuration, or it may, indeed, occasion fracture, or dislocation. But when the force is applied in flexing the limb, and only moderate force is employed, no danger can accrue to the patient.

*Ankylosis of the jaw* takes place either in consequence of cicatrices through injury to the mucous membrane of the cheek, or otherwise through inflammation of the temporo-maxillary articulation.

A cicatrix which results from destruction of the mucous membrane, even though it should not extend entirely from one alveolar border to the other, gradually and slowly contracts as cicatrisation becomes complete, until the teeth are firmly fixed, one row upon the other, so that they cannot be separated; and perhaps the only motion of the jaw which remains is a slight lateral motion. This cicatrix may easily be felt by

introducing the finger between the lips, and it may readily enough be divided. But this mode of treatment of cicatrices, whether of the mouth or elsewhere, seldom answers its intended purpose. Again, the cicatrix may be dissected out, but another will form, probably harder and more dense than the first. These cicatrices, which result from ulceration and sloughing of the mucous membrane of the mouth, are always preceded by such an amount of painful inflammation that the masseter muscle becomes in a measure affected by it; and it consequently happens that long before the cicatrix has formed to impede the separation of the jaws, the child refuses to open its mouth, and keeps it more or less locked. But this painful condition of the muscle results in structural shortening, so that after the cicatrix has been divided, the jaws can only be separated by further mechanical force.

*Treatment.*—The treatment in these cases should consist, in the first place, of subcutaneous section of the masseter muscle; and secondly, of the application of the wedge, which being first introduced between the teeth, may be forced in by means of a screw. This is the principle of treatment which is applicable to cicatrices in general, namely, gradual extension. The treatment is slow, and demands great patience, that the teeth may not be loosened, for should this happen it becomes impossible to extend the cicatrix. But should the cicatrix yield to gradual extension after section of the masseter, contraction will probably not again take place.

Inflammation of the temporo-maxillary articulation may occasion either partial or complete ankylosis,

the plastic matter which is deposited being converted into fibrous adhesions, or bony consolidation taking place.

The treatment of these affections of the jaw is greatly complicated by the circumstance of the articulation being surrounded and acted on by very powerful muscles, and also by the circumstance that these muscles—namely, the masseters, the pterygoids and the temporal muscles—are, perhaps, the last of the voluntary muscles to yield to the influence of chloroform, so that when they become relaxed, and the jaw drops, the patient will already have inhaled a very powerful dose of chloroform. It will easily be understood how this difficulty is increased when inflammation has produced thickening of tissues, with adhesions. When the adhesions are recent, they yield to the long-continued use of the wedge, and the mouth may be opened to its fullest extent. It requires, however, a very long and persevering application of the same means to prevent contraction taking place as before. With a strong will it may be done. It taxes, however, the best efforts of the patient severely. When these measures fail, nothing is left but to divide the masseter subcutaneously, and again to extend gradually with the wedges as before.

When bony ankylosis has taken place, either by fusion or by a bridge of bone, extending from the lower maxilla to the temporal bone (for these osseous bands not unfrequently follow the course of the ligaments), it is necessary to divide the ramus of the jaw. Whenever it becomes necessary to divide the ramus care must be taken so to divide it that the

false joint shall be formed in front of the impediment to motion, whatever this may be; otherwise the operation will be useless. When, however, the operator has the choice of position, it is well to select the sigmoid notch: less injury is inflicted in this position, and more power remains to the patient. Whether, however, this point be selected or not, a wedge of bone should always be removed, for in all operations on healthy bone there is a strong tendency to re-union when a simple section of the bone is made. Indeed, the strongest argument that can be used against the operation is this—that, notwithstanding the removal of a wedge of bone, there is a powerful tendency to bony re-union. I have only once seen a case in which bony ankylosis had taken place simultaneously on both sides of the jaw. This resulted as a sequence of gonorrhœal rheumatism.

* For other cases, I must refer to my paper on this subject in the 'Medico-Chirurgical Transactions,' vol. xl; and to my work 'On Diseases of the Joints involving Ankylosis.'

## CHAPTER XI.

### BONY ANKYLOSIS.

COMPLETE, bony, or true ankylosis is rare. When it has taken place, a sensation of solidity is communicated on grasping the limb above and below the articulation, such as can only be occasioned by continuity of bony structure. In fibrous ankylosis this sensation is never experienced. Fibrous ankylosis may, however, allow of so little motion that, with rigid muscles, it may be inappreciable, until chloroform has been inhaled. Therefore, as motion is thus masked, and as bony ankylosis is rare, it is safer not to express an opinion in favour of bony ankylosis until chloroform has been exhibited. When the patient is under the influence of chloroform, no doubt can exist as to the nature of the adhesions.

Bony ankylosis is the result of inflammation and suppuration within the joint, together with the destruction of the articular cartilages. Ankylosis may then result between the exposed surfaces of the bones, if the inflammation be of a reparative nature, causing the deposition of new bone. When destructive inflammation ensues, causing necrosis of the epiphyses, bony union is impossible. Diseased action must cease before repair can commence; and bony union is repair. This repair, however, may be of such a character as to be useless, and even worse

—it may be detrimental. Such cases then admit of treatment.

Ankylosis is occasionally observed as a congenital affection: the articular apparatus is then entirely absent. But in these cases an inconvenient angle is never found, and the reparative process is as complete as nature can make it.

In bony ankylosis the articular extremities are either bound together in the course of the ligaments or the bones are united in their entire thickness —two becoming fused into one. It has occurred to me once to see a living person without a single movable articulation: every joint was ankylosed.

Bony ankylosis is, however, rare; but union may take place at such an angle as to be in the highest degree inconvenient. Under these circumstances this repair, which is intended to be permanent and useful, may fairly be made the subject of surgical interference.

*Treatment.*—There are four operations which may, under certain circumstances, be done, to restore motion or to improve the position of the limb — viz., 1st, to remove a wedge of bone; 2nd, to break through the ankylosis, after drilling through the new bony formation; 3rd, to make a false joint; 4th, to divide the bone subcutaneously, and restore the position of the limb.

1. It was proposed by Dr. Barton of Philadelphia to remove a wedge of bone, when bony ankylosis has taken place with much deformity, so that the position of the limb might be improved; and he performed this operation on the person of a young physician, whose knee was ankylosed at a right angle. The following is his description of the operation:—

"Two incisions were made over the femur, just above the patella. The first commenced at a point opposite the upper and anterior margin of the external condyle of the femur, and, passing obliquely across the front of the thigh, terminated on the inner side. The second incision commenced also on the outer side, about two inches and a half above the first, and, passing likewise obliquely across the thigh, terminated with the other in an acute angle. By these incisions were divided the integuments, the tendon of the extensor muscles of the leg, at its insertion into the upper part of the patella, and some of the contiguous fibres of the rectus and crureus muscles themselves, a greater part of the vastus internus, and a portion of the vastus externus. A flap composed, therefore, of this structure was elevated from the femur, close to the condyles. The soft parts were next detached from the outer side of the bone, from the base of the flap towards the ham, by passing the knife over the circumference of it, so as to admit of the use of a saw. The flap then being turned aside, a triangular or wedge-like piece of the femur was easily removed by means of a small, narrow-bladed saw. This wedge of bone did not include the entire diameter of the femur at the point of section; so that a few lines of the posterior portion of the shaft of the bone remained yet undivided. By slightly inclining the leg backwards these yielded, and the solution was complete."*

The limb was supported on a splint at an angle corresponding to that of the knee previous to the

* 'American Journal of Medical Sciences,' vol. xxi. 1837-8.

operation; and subsequently it was brought into nearly a straight position by using a series of splints with varying angles; until at length the limb could be confined in an extended position so long as it was necessary to produce bony union.

2. Professor Brainard, of Chicago, proposed subcutaneous drilling and subsequent fracture as a substitute for the operation of Barton; and the operation has succeeded perfectly in his hands, and also as it was performed by Professors Gross and Pancoast at the Jefferson Medical College. The mode of operation was as follows:—

"Chloroform having been administered, a longitudinal incision, hardly one half of an inch in length, was made over the outer surface of the knee, near its middle, in a line with the groove between the head of the tibia and the external condyle, down to the two bones. Through this opening a steel perforator was introduced, keeping it as nearly as possible in the direction of the line of the articulation, and passing it on to the opposite side until the point could be felt beneath the integuments. The instrument was now moved about in such a manner as to cut through and break down the osseous adhesions between the femur and the tibia on the one hand, and the femur and patella on the other. The union between the bones was exceedingly firm; but, after much difficulty, it was finally overcome, and by forcible extension of the limb, the parts yielded with a cracking noise."*

When it is desired merely to gain a better position of the limb, one or other of these operations may be

* 'American Journal of Medical Sciences,' vol. lv. 1868.

performed where bony ankylosis with great deformity has taken place.

3. The third operation is that of establishing a false joint after section of the bone. This operation also was proposed and performed by Dr. Barton of Philadelphia. Dr. Barton's case was as follows:—Fracture of the femur had been followed by ankylosis at the hip-joint, and an angular union of the broken bone had resulted; so that the thigh was flexed, and the knee was carried across the opposite thigh. Barton cut through the femur between the trochanters, and straightened the limb. The wound of the soft parts was allowed to heal, but re-union of the divided bone was prevented by subjecting it to motion from time to time—such as rotation, flexion and extension, abduction and adduction. After some few weeks the ends of the bones became smooth, rounded and united by means of ligamentous bands; and thus an artificial joint was formed, which allowed of all the motions of the limb. This patient enjoyed the use of his artificial joint for six years; but after this time he gradually lost motion, and ankylosis took place.

This operation of Barton's was an admirable one, and the result, so far as it went, was excellent. There was this defect in it, however—that the section of the bone was made too far away from the original centre of motion.

When it is desired to re-establish motion in an ankylosed joint, the section should be made as near as possible to the centre of the articulation, so that the power of the muscles may not be unduly diminished. And with this view I operated, in 1861, on a case somewhat similar to Dr. Barton's, where

bony ankylosis was complete, but where there existed also some necrosed bone about the acetabulum. In this instance I cut through the neck of the femur immediately below the head of the bone, and then gouged away the remains of the head and the dead bone from the acetabulum. The wound healed almost in its entire extent by the first intention, and in three weeks it was firmly cicatrised, so that passive motion could be freely employed. In six weeks from the operation my patient began to use the limb in walking. This patient was a delicate person, and had not sufficient fortitude to continue the treatment which is necessary in these cases to retain free motion.*

In the next operation of this nature which I undertook, I removed the whole of the neck of the femur, and in consequence the fibrous connecting bands were somewhat longer and less firm, and from the commencement motion was more free than in the former case. My patient also was in good health, and carried out with a strong will my injunctions with regard to motion. In these cases it is important to continue passive motions of the limb, otherwise shortening of the uniting medium, with more or less loss of motion, may take place.

A chronic form of inflammation may be set up in cases of this kind, whether by accident or otherwise, which may result in loss of motion, just in the same manner as it may be set up in cases of fibrous ankylosis, where motion has been perfectly restored. Thus, in a case on which I operated, in 1856, in

* 'Proceedings of the Royal Medical and Chirurgical Society, vol. iv.

conjunction with Sir Duncan Gibb and Dr. Trouncer, motion at the hip-joint was perfectly restored, and my patient could walk easily, and without pain or unusual fatigue. He did not require a stick for support, and he habitually took much exercise. Motion at the operated joint was as free as in the other limb; but in 1867 he unfortunately fell on the ice and struck his hip, when inflammation followed, and tough adhesions were formed.

4. Where it is not desired to obtain motion, but only to rectify a false position of the limb, the bone may be divided subcutaneously, and an improved position may be given. I performed an operation of this character, with the assistance of Dr. Richard Brown and Mr. Potter, in the year 1865; and have subsequently had occasion to repeat it. In the present year Mr. W. Adams has at the Great Northern Hospital also in a similar manner cut through the neck of the thigh-bone. I think, however, that the operation of Professor Brainard, to which I have already alluded, is more simple and equally efficacious, and is therefore, on the whole, to be preferred to the subcutaneous section.

Langenbeck introduced subcutaneous osteotomy, and Meyer and Bauer have practised it during the last eighteen years. This operation has not found favour in England, however, and I am not aware that it has been performed, except by myself, until the present year, when Mr. Adams performed the operation to which I have alluded.

At the hip a false joint should be made; while at the elbow or at the knee a wedge of bone may be removed, or the ankylosis may be fractured after drilling through the bone.

## CHAPTER XII.

### CONGENITAL DISLOCATIONS.

These dislocations are found at birth, and are therefore termed congenital. They occur especially at the hip-joint. Other dislocations also occur, but they are subluxations rather than true dislocations; and they are found together with monstrosity, paralysis, idiocy, and alterations of the articular surfaces. In this manner, the shoulder, knee, elbow, wrist, and jaw are found in such cases to be luxated. Congenital dislocations of the shoulder, for instance, are partial displacements of the head of the humerus, simulating more or less true dislocations, with complete or partial paralysis of the muscles around the articulation; while those of the elbow and the wrist are always associated with malformation or monstrosity, and are produced by muscular retraction. Congenital dislocations of the knee are subluxations, which are to be treated by extension of the limb after subcutaneous section of the hamstring tendons. Thus, other forms of congenital dislocation occur together with anomalies of organisation, or they occur together with paralysis, or they are subluxations. But the dislocations of which I shall treat, at present, are those of the hip-joint.

These congenital dislocations of the head of the femur occur in three directions—namely, upwards and outwards, directly upwards, and upwards and forwards; but the first-mentioned variety, or that upwards and outwards, alone requires attention at this time, the other two forms of dislocation having only been seen in fœtal monstrosities.

Dislocation of the head of the femur upwards and outwards, on to the dorsum of the ilium, occurs for the most part on both sides simultaneously; and it occurs more frequently in the female than in the male child. Thus, Dupuytren mentions that, in the course of twenty years, he saw twenty-six instances of congenital dislocation of the femur, twenty-two of which occurred in female children, and only four in males; and that, with two or three exceptions only, all of these were instances of double luxation. I have had twenty-one cases of congenital dislocation of the hip under my care, sixteen of which have occurred in female children, and five in males. In two boys and three girls, the dislocation was single; in the remaining sixteen the dislocation was alike on both sides.

*Causes.*—It has long been a question how this form of dislocation is occasioned. Some, as Dupuytren, have believed it to be caused by defective organisation in the germ; while others, as Guérin, believe that active muscular spasmodic retraction causes not only congenital dislocations, but also all other congenital articular deformities. And Carnochan expresses a similar notion in the following words:—"Congenital displacements occurring at the ilio-femoral articulation result from active morbid mus-

cular retraction." I would place a single fact against this theory of M. Guérin's—namely, that in the cases of congenital dislocation of the head of the femur which I have seen, there has never been present spasmodic action of any muscle or set of muscles, whether of the muscles of the hip or elsewhere; nor have I ever known in these cases difficulty in guiding the limbs through disturbed nervous action. And therefore I cannot believe, with Carnochan, that "a pathological spasmodic retraction of the muscular tissue, resulting from a perverted or disturbed condition of the excito-motor apparatus of the medulla spinalis," is the cause of congenital dislocation. So far from any disturbance of the nervous system existing in these children, they are for the most part healthy; and I am unable to call to mind an instance of unusually delicate health in any child whom I may have seen affected with congenital dislocation of the hip.

The cause of congenital dislocation of the hip, as it usually presents itself, is a purely mechanical cause. This dislocation never occurs except with a preternatural labour, and it occurs especially with a presentation of the nates. When the breech presents, the child passes through the pelvis with the legs doubled up, and the feet towards the thorax. The blunt hook, or the finger, is sometimes used to assist the passage of the child; and for the sake of traction it is necessarily placed, when employed, at the top of the thigh. But, when the thighs are flexed upon the abdomen, the heads of the thigh-bones must press against the posterior and inferior portions of the capsule of the joint; so that traction

in this position will readily cause the head of the bone to escape from its shallow acetabulum.*

Some very rare instances of congenital dislocation have occurred where the head of the femur was misformed and the cavity of the acetabulum imperfectly developed; where also other deficiencies and abnormalities existed. These are referred to by Cruveilhier, von Ammon, and others. But these cases have little in common with those to which I have above alluded; for in these, and in all cases of this class, the children are healthy and otherwise well-developed and well-nourished.

*Symptoms.*—The symptoms of this dislocation vary with age. At birth it passes unobserved. When the child is lying down, the head of the femur is only slightly prominent; it may be felt, however, on rotating the limb. In the erect posture, the head of the bone becomes prominent, and presents visibly on the dorsum of the ilium above and behind the cotyloid cavity.

When dislocation of both thigh-bones has taken place, the pelvis is rendered very oblique, and the sacrum is raised; so that the abdomen is rendered prominent, and the lumbar region becomes re-

* It is beyond doubt that this dislocation is produced at birth through downward force applied to the thigh in endeavouring to hasten the birth in breech presentations. A slight click is heard while pressure is being applied, and at the same moment the head of the bone passes out of the acetabulum. It is possible that spasmodic muscular action may produce a similar effect; but this also occurs at birth in all probability, and not *in utero*. I lately saw a family of three children, one of whom had congenital dislocation of the right femur; another had congenital dislocation of the left femur and congenital talipes varus; and the third suffered from congenital dislocation of the heads of both thigh-bones.

markably hollow. The trochanters project unusually, and are placed nearer to the crests of the ilia than is natural; and the heads of the thigh-bones are to be seen projecting on the ilia, beneath the glutei (Fig. 53). The muscles of the dislocated limb remain small, from insufficient use; but children who are

Fig. 53.

thus affected are tolerably active, and can move about rapidly and without pain. Their motion, however, is very peculiar: it is, when both bones are dislocated, a rolling motion of the trunk, with more or less apparent insecurity or lameness. When the head of one femur is alone dislocated, the limb is shortened, so that the heel does not rest on the ground, and there is considerable weakness and yielding of the limb in walking; but the obliquity of the pelvis is less than when both bones are dislocated.

In the child the lumbar curve, which in the erect position is so considerable, is effaced in the recumbent position; and in this position the head of the bone may be drawn down upon the acetabulum, and the length of the limb may be restored.

*Pathological Anatomy.*—At birth the acetabulum is, I believe, never altered (in the cases of which I am now speaking—namely, those of dislocation upwards and outwards, where there is no other abnormality present), in shape or dimensions, and the head of the femur retains its normal appearance. Changes, however, subsequently take place, both in the cotyloid cavity and in the head of the bone, for the cartilage wastes and the cavity becomes partly filled up with cellulo-osseous material, while the head of the bone becomes at length somewhat irregular in shape, and its cartilage is thinned. The capsular ligament retains its integrity for some years: it becomes elongated; and as the head of the bone at length escapes through its capsule, the ligamentum teres, being stretched, becomes slender and finally gives way, when the

head of the bone comes into direct contact with the ilium. When the head of the bone has passed through its capsule a false articulation commences to be formed. Thickening of the cellular tissue with deposit of lymph takes place, which is ultimately developed into a new capsule, while a cavity is formed to receive the head of the bone by the deposition of osseous matter upon the ilium.

*Treatment.* — When dislocation occurs without other abnormality, both the acetabulum and the head of the thigh-bone are usually perfect at birth. There would then be neither difficulty in reducing the dislocation, nor in retaining the head of the bone in the acetabulum. The dislocation, however, is overlooked at birth, for the obvious reason that it is not suspected; and when it is discovered—probably after months and years have elapsed—changes have already taken place which tend to impede the reduction, and which prevent the head of the bone being retained in the acetabulum. Absorption of the head of the bone proceeds at the same time that the acetabulum is being filled up, while the tissues around the head and neck of the bone are undergoing degeneration—those which are stretched undergoing fibrous degeneration; those which are relaxed becoming weak and fatty; and those which are much exerted, hypertrophied.

At birth the diagnosis can only present any difficulty when the luxation is double; for when it is single the difference in the length and direction of the limbs, and especially the difference which must exist on the two sides of the pelvis, can scarcely fail to discover the dislocation. For the most part,

however, the dislocation is only suspected when the child begins to walk, and indeed it is often overlooked for years; but the peculiar gait—the lameness when the dislocation is single, and the rolling movement when both thigh-bones are displaced, is certain to attract attention. All the peculiarities of this dislocation are exaggerated when the patient is standing, and especially in walking; while, on the other hand, they are much diminished in the recumbent posture, and it is for this reason that congenital dislocation of the femur is seldom discovered until the child begins to walk alone: then the peculiar gait attracts attention.

The peculiarities of this dislocation were very strongly marked in a boy lately in the Grosvenor ward of St. George's Hospital. In this case both limbs were dislocated, and the trochanters projected abnormally and approached nearer to the crests of the ilia than in their natural condition, and the heads of the thigh-bones were seen projecting on the ilia beneath the glutei. The pelvis was thus rendered very oblique, the sacrum being raised, and the pubes carried backwards, while the lumbar and lower dorsal vertebræ were curved forward, rendering the abdomen protuberant. The knees, in these cases, are directed inwards, and the feet are flat. The lower limbs are weak, and wanting in muscular development, while the muscles of the arms and of the upper part of the trunk are largely developed, and are much used in progression. This boy was twelve years of age, and the changes to which I have referred had already taken place in him, so that the head of the bone was more or less fixed in its new cavity. But before this

period has arrived, and while the cartilaginous surfaces retain their integrity, the dislocation may be reduced, and the head of the bone may be retained in the acetabulum. It is probable that until muscular retraction has taken place, this replacement may always be effected by manipulation under chloroform, and that the head of the bone may be retained in the acetabulum with the help of bandages and splints; but when retraction of the powerful muscles about the neck of the bone has taken place, although the dislocation may be reduced under chloroform, these muscles again displace the bone. These considerations induced me to propose the subcutaneous section of the muscles which are inserted into the trochanter.

It must be borne in mind that there is no difficulty, even after some years have elapsed, in restoring the length of the limb, by drawing down the head of the femur to rest on the acetabulum; but there is great difficulty in retaining the head of the bone in that position. I therefore resolved to divide subcutaneously those muscles which tend to displace the bone—namely, those which are inserted into and about the trochanters, especially the glutei and the rotators; and I found that, when the head of the femur was drawn down to the acetabulum, these muscles having been divided, it remained in that position and did not undergo displacement, even though retentive appliances were not immediately used.

On the 21st March, 1865, I first performed this operation. I had been consulted by Mr. Herbert Barnes respecting a case of congenital dislocation of

the head of the femur some months previously, when I proposed the operation to which allusion has been made; but it was not at first acceded to. Extension, as recommended by Pravaz and Gillebert d'Hercourt, was therefore employed for many months, but without any real advantage being gained; and consequently it was determined to resort to operation.

With the assistance of Mr. Holmes I divided all the muscles which are inserted into and about the trochanters, especially the glutei and the rotators. The head of the femur was then drawn down to the acetabulum, and it was found that it remained in that position, and that there was no disposition to displacement. The limb was bandaged to a straight thigh-splint, and sufficient extension was employed to keep the head of the femur in contact with the acetabulum. This was easily effected, there being no disposition to retraction. In two months after the operation consolidation had advanced about the head of the bone so thoroughly that there was no disposition for the head of the bone to escape, but it remained perfectly *in situ* while passive motion was employed. The natural motion of the hip-joint was imitated daily for a month, and the child was then allowed to walk with an instrument, which was so contrived as to prevent the escape of the head of the bone from the acetabulum, but which allowed the movements of the limb to be free. This instrument was worn during the day for six months. After this time it was not worn constantly; and at the end of twelve months it was discontinued. At that time the child walked strongly and without limping; and

indeed there was scarcely any peculiarity of gait. She required no other assistance than a thickened sole to her boot, to the extent of about one eighth of an inch, to enable her to walk well.*

This, then, is the operation which is applicable in these cases, and from which I have derived in several instances excellent results.†

After the section is complete the limb should be fixed to a straight thigh splint, and sufficient extension be made to hold it in the desired position; and after an interval of six weeks or two months passive motion may be employed. After this time consolidation has taken place about the head of the bone which tends to prevent displacement; but it is necessary to continue the use of a retentive apparatus for many months without cessation.

One of the last cases of this description on which I operated was that of a boy four years of age, whose right femur was dislocated. This child walked with help and a sustaining apparatus in the course of six months; and in the seventh month he could walk without his apparatus and without any displacement of the head of the femur occurring; but the limb was still weak and required support. When he was lying down, he had complete control over the limb, and could move it in every direction.

In children under two years of age it will probably not be necessary to have recourse to this operation, for the head of the bone will probably be retained after replacement, and with-

* 'St. George's Hospital Reports,' vol. i.

† See Holmes, 'On Children's Diseases,' p. 220.

out subcutaneous section; but after this age, displacement will scarcely be prevented without operation.*

* For further information on this part of the subject, I must refer the reader to my article on "Congenital Dislocations" in Holmes's 'System of Surgery.'

# CHAPTER XIII.

## OLD UNREDUCED DISLOCATIONS.

SINCE chloroform has been in use we have been compelled to modify our opinions on various questions relating to operative surgery, and especially this is the case where it is necessary to overcome the influence of the muscles; as, for instance, in the reduction of a dislocation.

Before chloroform was in use, it was the law that in dislocations of the hip attempts at reduction should not be made after eight weeks of displacement, and in dislocations of the shoulder the limit was fixed at three months.

Now, when dislocation has occurred and the capsule is rent, inflammatory thickening takes place around the extremity of the displaced bone, adhesions form, and ultimately a new capsule is developed, the surrounding cellular tissue becoming condensed. In the orbicular joints especially, motion is easily established, and the new capsule becomes perfected through motion: it is furnished with a smooth lubricating lining, and in many instances free motion is in time permitted. Also a cavity is formed to receive the head of the bone. If the head rests on muscle the muscle becomes dense, and is hollowed out for its reception; if it rests on bone, a cavity is formed

to receive it, in part by absorption of the old bone, such as the ilium or the scapula, in part, also, by the deposition of new bone; and this is at length lined either by ligamentous substance or by a smooth porcellanous deposit. But, on the other hand, the head of the bone may be displaced in such a manner as to press on neighbouring vessels and nerves, so that not only is motion so painful that it cannot be borne, but in such a position the pressure of the head of the bone, even while at rest, causes in many instances more or less constant pain. So long as it is necessary to keep the limb at rest a new joint cannot be formed, for motion is absolutely necessary not only for the perfection of the new articulation, but also for its development.

Thus, in old unreduced dislocations two distinct conditions may be observed. On the one hand, nature remedies the effects of a dislocation by the development of a new joint; while, on the other hand, adhesions form around the head of the bone and consolidation takes place. These tend to fix the limb and prevent painful motion. In the former case the limb daily gains strength, as the new joint becomes more perfect; while in the latter, atrophy of the limb results.

*Treatment.*—In the treatment, therefore, of old unreduced dislocations, with the advantage which chloroform gives us, the amount or absence of repair must be considered, rather than the length of time during which the limb has suffered displacement; for although it may remain a question for the operator to determine whether it is desirable to attempt the reduction of a limb which is regaining power and motion,

it can scarcely be otherwise than right to attempt to reduce a dislocation where the limb remains motionless or painful.

These questions of motion and pain may well be allowed to guide us in every instance in which we are called upon to decide on the feasibility of an operation in such cases; for where the limb has not been used, very slight change takes place in the articular surfaces, so that I am unable to fix a limit to the period at which it could truthfully be said that such an operation would be unjustifiable. The health and the age of the patient are questions to be considered, not alone before performing this operation, but in every other operation; and therefore these questions will of course be considered by every prudent surgeon before he determines to reduce an old dislocation. When it is remembered that the acetabulum may retain its form and depth and its cartilage after the head of the femur has been dislocated for thirteen years, it will be understood that it is difficult to assign a limit to these operations. Fournier has placed a dissection on record where the head of the femur had been dislocated during thirteen years, and in which the acetabulum retained its form and depth and cartilage.*

After the patient has been placed fully under the influence of chloroform, so that muscular resistance has entirely ceased, the adhesions which have formed around the head of the bone are to be broken up by free motions of the limb—to-and-fro motions and motions of rotation—which shall leave the head of the bone free and movable. The adhesions are thus

* 'Bulletins de la Société Anatomique,' 1855.

to be broken through by applying moderate force only: violence can never be justifiable. When the head of the bone is fully loosened from its attachments, the limb is to be so manipulated that the head of the bone is drawn towards or carried into its articular cavity; and there it is to be immediately fixed by appropriate bandages, lest it should again slip out. I have never known the head of the humerus even to become again displaced after the limb had been bandaged and supported by a pad in the axilla.

Some time ago I saw, with Mr. Chalk, a patient, fifty-three years of age, who had fallen from a height of twenty feet and dislocated the humerus beneath the pectoral muscle. The swelling was considerable at the time, so that the dislocation was not discovered by the surgeon who first saw this patient; but afterwards an attempt at reduction was made, which, however, was not successful. Four months later he presented himself at a large metropolitan hospital, that an attempt at reduction might be made. He was persuaded, however, not to submit to any attempt to replace the head of the bone. Two months after this I saw him. He was suffering acutely, and was unable to move the limb or to carry it without support. Any attempt at motion caused excessive pain, especially about the neck of the humerus and in the region of the elbow.

The head of the humerus could be distinctly felt lying beneath the pectoral muscle, where it appeared to be firmly fixed. The deltoid, biceps, and pectoral muscles especially were atrophied; but also the whole limb was wasted. The fingers were numb. The elbow was somewhat removed from the side, and was inclined backwards, where it was fixed and immovable; the forearm was flexed, and the hand was carried forwards.

Under these circumstances we determined to endeavour to replace the head of the bone; and although the humerus had been dislocated for 175 days, we considered ourselves justified in making the attempt at reduction. The patient was therefore

placed completely under the influence of chloroform, and the scapula was firmly fixed both laterally and from above. The adhesions about the head of the humerus were then broken up by to-and-fro motions of the humerus and by freely rotating the head of the bone. Then seizing the wrist, I drew the arm directly upwards, when the head of the humerus immediately slipped into the glenoid cavity with a slight click. A pad was placed in the axilla, and the arm was bandaged to the side. The patient remained in bed for three days, and on the sixth day the bandages were removed, and gentle motion was commenced. There was no disposition at any time for the bone again to become displaced.

After some considerable time the power of motion was in great measure, if not entirely, restored; pain and numbness ceased, and there was no difference in the fulness of the two shoulders; so that when I last saw him this arm was almost as useful as the other.

When pain has subsided, passive motion may be commenced; perhaps after ten days or a fortnight shall have elapsed.

In some cases of old dislocation it may be necessary to divide the tendons of retracted muscles before attempts at reduction are made. This was done in the following case.

Elizabeth C—, nineteen years of age, was admitted into the hospital with an old dislocation of the wrist forwards on the 8th of July, 1868. This dislocation resulted from a fall on to the palmar surface of the extended fingers; and this occurred six years before her admission into the hospital. The wrist and fingers had entirely lost all power of motion. On the day after her admission into the hospital I divided the flexor tendons subcutaneously, namely, those of flexor carpi radialis, palmaris longus, flexor sublimis, and flexor carpi ulnaris; and four or five days later, the punctures having healed, chloroform was administered, the adhesions were ruptured, and the hand was restored to its normal position by flexing and subsequently extending the hand

upon the forearm. The limb was then laid upon a straight splint and bandaged firmly to it. After some few days passive motion was commenced, and for this purpose an instrument was constructed with a joint corresponding to the wrist-joint, which supported the extremities of the radius and ulna and the carpus, and which allowed of motion without displacement of the wrist.

This patient regained entirely the use of her hand and wrist, and was able again to follow her occupation in the same manner as before the accident.

In these cases, then, of old dislocation, attempts at reduction may be made so long as the limb remains painful or motionless; and when much muscular retraction has taken place the tendons should be divided, and the punctures be allowed to heal, before the adhesions are broken through and attempts are made to replace the limb in its normal position.

## CHAPTER XIV.

### CONTRACTED CICATRICES.

I HAVE had occasion in Chapter X to allude to cicatrices of the mouth; and Figs. 38 and 39 show a contracted cicatrix from a burn, while in Fig. 33 is represented a somewhat similar distortion produced by a lacerated wound and subsequent contraction of the cicatrix.

If it is extremely difficult to prevent contraction of cicatrices such as those to which I have alluded, yet it must be confessed that many of these contractions result from want of ordinary care during the healing process, and especially after cicatrisation is complete, or nearly complete.

These contractions occur especially in the region of the neck and the axilla. They are met with, however, affecting the flexures of all the joints, whether the elbow, the wrist and hand, the knee or the foot; but the neck and the axilla are more frequently affected in this manner than the other regions of the body, for they are more exposed to the rising flames when the clothes catch fire, and also to a longer continuance of the action of the fire.

Thus, through the destruction of the integument of the neck, the entire surface of the front of the neck may be exposed, and a contractile cicatrix forms which draws down the chin upon the thorax;

the lip becomes everted, and its red edge may be united with and blended in the cicatrix; the saliva cannot then be retained, but dribbles from the mouth, and the teeth being unsupported by the lip, are everted, and at length becoming loose are eventually detached. Then, although the face itself may not have been touched by fire, the contracting cicatrix having drawn the angles of the mouth downwards, the eyelids eventually become everted; and the outer canthi especially being drawn downwards, the eyeballs remain uncovered.

In the axilla the contracted cicatrix may bind the arm so firmly to the side as to prevent entirely the motions of the arm. I have known the web extend to the elbow. And in the same manner wherever the flexures of joints have been injured by the action of fire, contraction of the cicatrix may take place so as to produce deformity of the limb, or even dislocation of the smaller joints.

In the flexures of the larger joints the tendons become contracted together with the fascia and the subcutaneous structures, but this depends on the depth of the burn: the superficial layers of the skin may alone be injured, and then cicatrisation is completed without deformity being produced. But, on the other hand, when the skin is destroyed in its entire thickness, contraction takes place during the process of cicatrisation and after cicatrisation is complete.

*Treatment.*—The period at which the treatment of these accidents is undertaken is an important element in the consideration of the case, and of the mode of treatment to be adopted. Further, the treatment

must differ somewhat according as the burn is superficial, or as it involves the deep structures. A recent cicatrix is comparatively more extensible than one which has existed for many months ; and the cicatrix may consist of integument only, or there may be involved powerful tendons together with it.

The modes of treatment vary, then, according to the region which may be affected ; and also they vary according to the duration of the cicatrix, and the depth of the burn.

The modes of treatment are, first, extension by means of the rack-and-pinion movement ; second, extension by passive movements ; third, the clamp ; fourth, division of the cicatrix, and the introduction of a flap of sound skin ; fifth, division of the cicatrix and replacement of the parts in their normal positions, and subsequent engrafting of portions of skin.

1. The rack-and-pinion movement is applicable to cicatrices of the neck, especially where the contraction is not of long standing, and where the lower jaw is not so embedded in the cicatrix that there is difficulty in applying the extending power. If the extending instrument can be so applied as to grasp the chin and the base of the jaw, it is possible by means of rack-and-pinion movements affixed to an instrument to raise the chin, and consequently to raise the lip, and so to prevent the dribbling of saliva.

The base of the instrument may be fixed either on to the pelvis or the shoulders, whence a stem rises to the head, from which arms proceed to fix the head and throw it back, and thus raise the chin. Whatever may be the shape of the apparatus to be employed, care must be taken to moderate the pressure

upon the jaw, so that sores may not be formed, and also that the cicatrix may be extended slowly. Rapid movements cannot be borne: violence of any kind will produce inflammation, which will proceed rapidly to destruction of the lowly organized tissue.

Again, gradual extension by means of the rack-and-pinion movement may be employed with great advantage wherever instruments can be accurately fitted to the affected parts, as to the arm and fore-arm, the leg and thigh, the fingers, &c.

In this manner the contraction which is represented in fig. 54 was overcome. Here was a rec-

FIG. 54.

tangular contraction, which had existed for eighteen months in a young person nineteen years of age. In the course of four months the web was entirely removed, and the motions of flexion, extension, and rotation were again perfect. Not only was the web removed, but the skin of the arm, which previously was puckered and rough, became smooth and even.

When extension of the web has been accomplished by the means above detailed or by passive motion, contraction never again takes place.

When contraction has taken place in the hand, and the fingers are drawn down more or less into the palm, the palmar fascia and the subcutaneous tissues being thickened, hardened and contracted, with, perhaps, loss of substance, extension becomes, not only extremely difficult, but the treatment is frequently unsatisfactory. Then it is perhaps necessary to divide tendons and processes of fascia before extension can be adequately undertaken.

The same course of treatment should be adopted at the elbow and the knee, and, indeed, wherever tendons are shortened, or wherever, by their contracted condition, they tend to impede the progress of extension. Whatever may tend to facilitate the extending process recommends itself very strongly for adoption in the treatment of contracted cicatrices, and nothing facilitates the process of extension where structural shortening has taken place more than the subcutaneous section of the tendons involved in or connected with the cicatrix.

2. Extension by passive movements is especially applicable after contraction in the axilla has taken place, when the cicatrix is recent. In this situation the powerful leverage which is afforded permits of the adoption of passive movements with remarkable effect.

Lately there was under my care at St. George's Hospital a patient, sixty years of age, who had been extensively burnt on the back and breast and in the axilla, and in whom, when she presented herself at the hospital, cicatrisation had taken place over the entire surface, with the exception of a space on the back equal to the palm of a man's hand. The arm

was bound firmly to the side, and could not be raised away from the side; but because the contractions were recent it appeared to me a favorable case for the employment of passive movements, and I therefore directed that they should be used daily.

At first the hand alone was used to raise the patient's arm, the shoulder being at the same time securely fixed with the other hand; but as the web yielded and a greater range of motion was gained, a cord and pulley were so arranged that as much force as could be borne was easily applied. In this way the contracted cicatrix gradually yielded, and the motions of the shoulder-joint were again perfectly restored.

Passive movements may also be employed at the elbow- and at the knee-joints; but they are especially applicable to contractions in the axilla.

3. When the web is extensive, and especially when it is also thin, the clamp may be employed with advantage. The clamp is to be employed at the root of the web, the web being first punctured by a barbed screw, which carries one side of the clamp. After the web has been punctured the sharp point is removed, and the upper portion of the clamp is then placed upon the web and is tightened with the screw. A slough is thus produced by the clamp. The metal is then removed, and the slough having separated, a piece of oiled lint is to be introduced into the wound and cicatrisation of the edges of the wound promoted. When cicatrisation is sufficiently advanced the remainder of the web is to be divided from the aperture to the free line of the web. The cut edges are dressed and kept asunder, and where it is

necessary, gradual extension is made to restore at the same time the normal position of the limb.

This mode of treatment has been in vogue for many years for webbed fingers. It was first introduced in the year 1861, in a case on which I operated together with Dr. Forester; and the principle, with a slight modification of the instrument, has since been adapted by Mr. Tamplin to the contracted cicatrix of a burn, and by Mr. W. Adams in 1868 to a very extensive web, which reached from the knee to the foot, distorting the foot.

4. When the chin is so bound down by the cicatrix that it is impossible to fix an extending instrument to the jaw, when, in fact, gradual extension of the cicatrix is impracticable, the cicatrix, or such parts as shall liberate it, may be divided across and flaps of sound skin be implanted in the gap. If the adhesion of the transplanted flap could be secured this operation would be a great success; but, inasmuch as this is seldom the case, the flap sloughing in a large number of instances, entirely or in part, this is an operation to which recourse should be had only as a last resource.

5. Having divided the cicatrix or the skin in such a manner as to liberate the parts affected, as in the last-mentioned case, the jaw for instance may be raised to its normal position, and there held by a suitable instrument; and when the exposed surface is covered with healthy granulations, portions of skin may be engrafted on the surface after the method of Reverdin.

I have only once had occasion to operate in this manner, but the result was so excellent that I shall

repeat it on the first opportunity, and I do not hesitate to recommend it. Cicatrisation is scarcely yet complete as these pages are passing through the press, yet it is obvious that this mode of operating is to be preferred to that above described as the flap operation.

The operation was done on a child six years of age, whose chin was bound down to the sternum. The cicatrix had existed for fourteen months, and was both tense and hard. Having divided it across, and kept the chin and sternum well asunder, I introduced, on the fifth day after the operation, three small portions of skin, each about the size of a threepenny piece, from the side of the neck on to the granulating surface. They were covered with lint, and not disturbed for four days. Cicatrisation went on rapidly from these points, and the whole wound was nearly filled up in the course of three weeks.

I am disposed, on the next occasion of operating not to engraft, but to leave portions of the skin in raising the flap. This may readily be done with a little careful management, and it is probable that the effect would be more certain than by engrafting. It would be impossible that anything should have succeeded better than the engrafting process as it was carried out in the instance above mentioned; but it cannot always be relied on to an equal extent. To leave small portions of skin attached in raising the flap, if this were found practicable, seems to me likely to ensure a more certain result.

Such, then, are the modes of operating in these cases according to the position and degree of contraction, and the view of the operator.

# PART III.

# DEFORMITIES OF THE TRUNK AND NECK.

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## CHAPTER XV.

### CURVATURES OF THE SPINE.

Curvatures of the spine are met with, especially, in three varieties — namely, anterior, posterior, and lateral curvature.

The antero-posterior pathological curves are, for the most part, merely exaggerated conditions of the physiological curves. Thus we find anterior curvature existing especially in the lumbar region, and posterior curvature in the dorsal region. It will be shown farther on, however, that these conditions are not absolutely limited to a given region; but that the vertebræ above and below may be involved in the curve, so as to reverse the normal curve of any region. These curves are rarely congenital; but are for the most part induced through ignorance or neglect on the part of the nurse, or otherwise through deficient nutrition.

Before proceeding to consider these pathological

conditions, however, it may be desirable to examine the normal—physiological—curves of the spinal column, as they occur in the *fœtus in utero*, after birth, and in the adult; and to consider very briefly their formation and their purposes.

## NORMAL OR PHYSIOLOGICAL ANTERO-POSTERIOR SPINAL CURVES.

The spine in the fœtus is bent forwards; its curve being moulded by the walls of the uterus: the head is bent upon the breast, and the thighs are folded upon the abdomen.

In the infant, the spine remains almost straight while in the horizontal position. The sacrum is only slightly curved, and the pelvis is more oblique than in the adult.

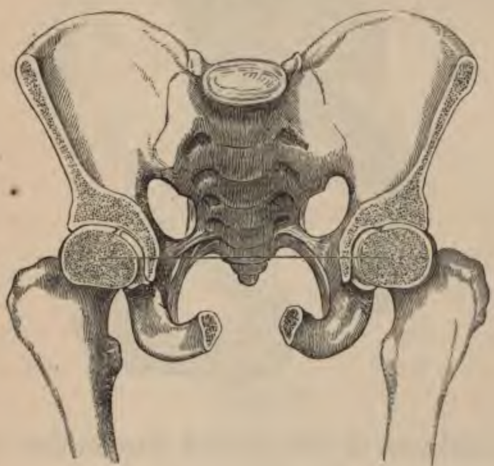
The normal—antero-posterior—curves are developed slowly, and depend in great measure on muscular action, and on the erect position which man is destined to assume. At birth these curves do not exist; and even in the young child they are not constant, for they disappear when the horizontal position is resumed. Gradually, however, the antero-posterior curves become more or less permanent; and, before growth is complete, the spine is found to have gained, as a constant condition, lumbar, dorsal, and cervical curves; while, on the other hand, it has lost much of its flexibility.

On examining carefully the spinal column of the adult in the erect position, it will be seen that the

base of the sacrum is so placed that it is to be found immediately above a straight line which may be supposed to pass through the heads of the thigh-bones, and which is known as the interfemoral line. This is shown in the following figure (Fig. 55). The fact was demonstrated by MM. Weber.

Naegele first showed exactly the position of the pelvis in the upright posture. Prior to his demonstration of the fact, it was believed that the pelvis was

FIG. 55.



more horizontal than is absolutely the case. The pelvis is so oblique that the anterior wall (pubes) presents upwards and backwards, and the posterior wall (sacrum and coccyx) downwards and forwards, as is shown in Fig. 56. Such, then, being the positions of the pelvis and the sacro-lumbar articulation, the question arises, how is equilibrium maintained?

Equilibrium is the result of certain forces acting in front of and behind the spinal column; namely, the action of the flexors and the extensors of the trunk, neck and head, and the resistance of the ligaments that hold together the several vertebræ which form the spinal column. In the erect posture these structures combine to poise the head and the

FIG. 56.

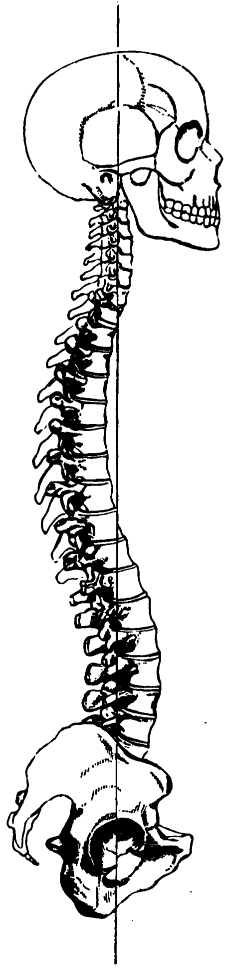
vertebral column in the vertical line on the heads of the thigh-bones. (See Fig. 57.)

In considering this question, the weight of the viscera should not be forgotten. At the present time, however, the chief points can alone be taken into consideration.

The position of the sacro-vertebral articulation being, then, such as has been described, it becomes necessary for the maintenance of equilibrium, and that the head may be poised (its centre of gravity

corresponding with a vertical line which coincides with the axis of the trunk, and which shall fall on

FIG. 57.



the interfemoral line), *first, that the lumbar vertebræ shall be curved backwards.* This lumbar curve is the

result of muscular action in the endeavour to maintain the erect position. It is the reverse of the sacral curve; and it springs from the sacro-lumbar articulation upwards and backwards, the sacral curve commencing at the same articulation, and presenting downwards and forwards. When a curve has been formed, it is essential that a second curve—dorsal—shall restore the direction of the spine towards the perpendicular line; and, for a similar reason, a cervical curve is formed in the same direction as the lumbar curve. These several portions of the spine differ somewhat in flexibility, the lumbar and dorsal portions possessing this quality very nearly in equal degrees; but in the cervical region the flexibility is three times greater than in either of the other regions. Thus, a structure is composed of segments of various circles, strong, yet elastic, fitted to bear the superincumbent weight, and yet capable of resisting the effects of shock.

It would, perhaps, be impossible to imagine a structure more perfectly adapted to its purposes than the spinal column, formed as it is of separate pieces, which are severally united by discs of fibro-cartilage, bound together by numerous and strong ligaments, and surrounded and acted on by powerful muscles. Its flexibility and its curved form are points of even, perhaps, more importance than its great strength: these adapt the spine specially to its purposes.

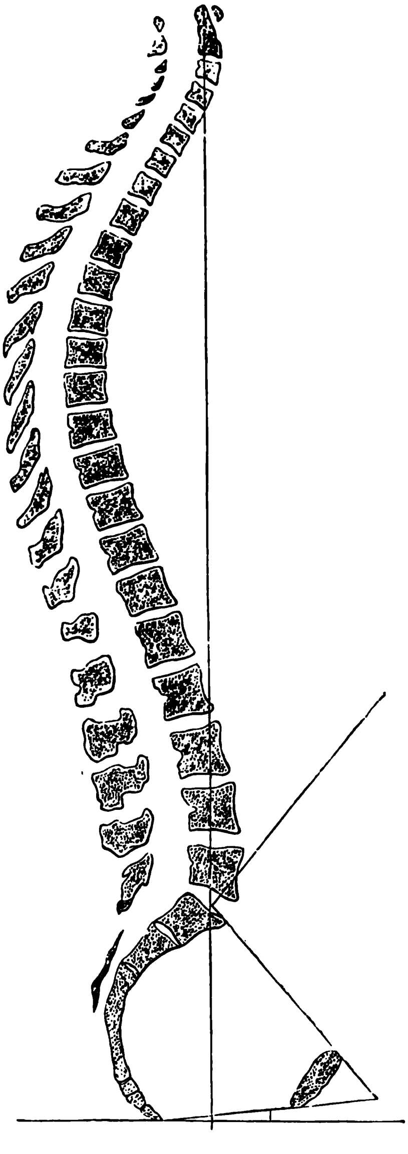
I do not desire in this place to enter minutely into questions of physiology, and will therefore only allude to the opinions of some eminent physio-

logists, as the Webers, Cruveilhier, Bishop, and others, who have stated their belief that the normal curves of the spine depend on varying thicknesses of the bodies of the vertebræ and the intervertebral substances. It is true, as the Webers have shown, that, in the dorsal region of the spine especially, differences exist on the anterior and the posterior surfaces of the vertebræ; namely, that on their anterior surfaces, in the concavity of the curve, the vertebræ are somewhat thinner than they are posteriorly; while in the lumbar and in the cervical regions the fibro-cartilages are especially affected, being compressed posteriorly.

To show the varying thicknesses of the anterior and the posterior surfaces of the vertebræ and the intervertebral cartilages, the Webers caused the spine to be bisected in the mesial plane, after the viscera had been removed from the cavities of the thorax and abdomen and their spaces filled up with liquid plaster of Paris. The relative normal positions of the various portions of the spinal column were thus obtained, and from the section the accompanying figure (Fig. 58) was taken, which represents most accurately the forms of the several curves and the proportions of the bones and cartilages which together constitute the spinal column.

But it has been already shown that the physiological—antero-posterior—curves do not exist at birth; and that, when first observed, they are not permanent, but are lost in the horizontal posture. Further, these inequalities in the vertebræ and the intervertebral substances do not exist at birth, nor are they found until the spinal curves commence to

Fig. 58.



be permanent. Also, they increase with age. Such being the case, it follows as a necessary consequence that these differences in the anterior and posterior surfaces of the bodies of the vertebræ, and especially of the fibro-cartilages, are due to the antero-posterior curves—are due, in fact, to the erect position and to the pressure from above downwards consequent on that position.

The effect of pressure on the intervertebral cartilages is shown by the loss of height which is sustained at the end of the day. Thus it is well known that a man of middle stature, who remains in the erect posture during the day, will lose nearly one inch in height, and that this is regained only after he has been in the recumbent position for six or eight hours. We must conclude, therefore, that these varying thicknesses of the bodies of the vertebræ and of the intervertebral substances are produced by pressure as a result of the erect position, and that they would never be developed any more than the antero-posterior curves themselves, in the horizontal position.

Thus, it may be stated that the antero-posterior curves of the spinal column result as a consequence of the erect position and from muscular action in maintaining equilibrium, and that unequal pressure occasions thinning of the bodies of the vertebræ and the intervertebral substances in the concavities of the curves. This view will be confirmed by the consideration of pathological curves.

# CHAPTER XVI.

## ANTERIOR CURVATURE OF THE SPINE.

Anterior curvature of the spine affects, for the most part, the lumbar region of the spine, and is an abnormal increase of the physiological curve of that region. It occurs also, however, in the cervical region in infants. It is then due to rickets and want of muscular power, and sometimes also to caries. When anterior curvature takes place in the lumbar region it is, for the most part, of rachitic origin. Sometimes it is hereditary, and then, also, it depends on a rickety condition; and, again, it results, as has been already mentioned, from congenital dislocation of the heads of the thigh-bones. In these cases distortion is sometimes very remarkable. I lately saw a child in whom this result of dislocation had been treated during three years as a primary affection, and without any suspicion being excited as to the immediate cause of curvature.

Anterior curvature is for the most part limited to the lumbar region of the spine, the dorsal and sacral portions being implicated only in so much that their normal curves become exaggerated. Occasionally, however, a part, or even the whole, of the dorsal curve may be reversed; and then the anterior curve will consist of the lumbar vertebræ together with the dorsal.

*In the lumbar region* this distortion may vary from a slight increase of the normal curve of this region to a development which is a source of great weakness. The normal condition has already been shown. Through increase of this curve the obliquity of the pelvis is augmented, the anterior wall being carried backwards and the sacrum and coccyx being raised, so that their concavities present more directly downwards, and the superior portion of the pelvis inclines forwards. The sacro-lumbar articulation, in consequence, is no longer found immediately above the interfemoral line, but in advance of that line. Thus the equilibrium of the body is disturbed, and it is necessary that the weight of the upper part of the trunk shall be thrown behind the vertical line of the body. In this manner a compensatory antero-posterior dorsal curve is produced.

*Symptoms.*—The external appearances presented by this distortion, then, are such as are indicated by the changes in the skeleton above mentioned. They are well represented in Fig. 59. The lumbar region is rendered remarkably hollow, while the dorsal is rounded; the nates are raised, and the head is thrown back. The abdomen is unusually prominent, and the stature is necessarily stunted. When the distortion occurs in childhood growth is impeded, and when it takes place in the adult much loss of height is incurred.

*Causes.*—The causes of lordosis are numerous. As a congenital affection it is combined with monstrosity and with spina bifida. In childhood this deformity is sometimes observed as a result of rickets.

An hereditary disposition to lordosis is also some-

times observed; one or more members of a family being affected. It may be the only sign of a rachitic tendency, or a more severe and general form of rachitic affection may present itself. In some members the cachexia is so marked that the whole

Fig. 59.

skeleton partakes, and no portion of it remains unaffected. When the pelvis is much contracted and anterior spinal curvature is at the same time considerably developed, natural parturition may be prevented, and the Cæsarean section, or other such means, may become necessary for the removal of the

fœtus. Such instances are recorded by Ramsbotham, Kilian, and others. In these cases softening of the bone had allowed excessive distortion to be produced; but it is inaccurate to describe this distortion as dislocation. It is not possible, even in extreme instances of distortion, that dislocation of the lumbar vertebræ shall be produced in these cases. The instances of distortion which have been thought by some to be dislocations, have been proved to be rachitic distortions, both by the positions of the spinous processes, and by the general conformation of the trunk.

Whatever tends to increase the obliquity of the pelvis will give rise to this form of distortion. Thus, it is a necessary consequence of congenital dislocation of the heads of the thigh-bones (upwards and outwards). In some instances arising from this cause the distortion is very remarkable. A child was lately under my care for congenital dislocation of the thigh-bones, in whom lordosis was very marked; so much so, indeed, was it, that the congenital dislocation had been entirely overlooked, and attention had been directed to the spinal curvature alone—a result only of the dislocation.

Lordosis may be induced equally by unreduced non-congenital dislocation of the thigh-bones. Thus, it exists in a very marked degree in a young man, twenty years of age, whom I lately had occasion to see, who has suffered successively in each hip-joint with rheumatic inflammation and subsequent dislocation of the head of the thigh-bone on to the dorsum ilii, and in whom it was impossible, notwithstanding every care, to arrest the disease. In these

cases, as in those last mentioned, great efforts are made to sustain equilibrium ; the extensor muscles of the trunk are tense and prominent, and, standing out firmly, they leave, especially towards the lower part of the spine, a deep sulcus in the median line.

I lately saw, together with Mr. Brookes, a similar deformity, but arising from a totally different cause, at Shaldon, in Devonshire ; and I allude to the case because it is rare. Fatty degeneration of the muscles of the abdomen had taken place, and the abdominal viscera hung suspended consequently in a huge, tumid paunch ; the weight of which had, in part, occasioned the distortion in question. This distortion was one of the most remarkable that I ever witnessed. The effect was increased, also, by fatty degeneration of many other muscles, such as the trapezii, rhomboidei, serrati, latissimus dorsi, the pectoral muscles, and those of the lower extremities. Many of these muscles were so far destroyed that they could not even be traced. In this instance, the unsupported pendulous belly, together with the loss of muscular power, seemed to give rise to lordosis, in a somewhat similar manner to that in which the gravid uterus is sometimes known to act.

Bearing heavy weights round the neck and shoulders will also occasion lordosis. That a considerable burden may thus be slung, borne upon the neck and shoulders and suspended in front, it is necessary that the shoulders shall be thrown back, and that, consequently, the loins shall be projected forwards. If this practice is continued, the increased lumbar curve becomes more or less permanent. I

have also known gymnastic exercises to produce a somewhat similar result.

*Pathological Anatomy.*—The pathological changes which are induced are chiefly as follows. The lumbar spines are approximated; the articulating processes of the vertebræ are pressed forcibly into contact one with another; the posterior ligaments become somewhat shortened, and the ligamenta subflava lose something of their elasticity; the bodies of the vertebræ undergo absorption, and the intervertebral substances are compressed posteriorly; while expansion of these substances takes place on the anterior surface in the convexity of the curve. The extensor muscles of the trunk are strongly developed. Ankylosis of the articular processes of the vertebræ, with or without fusion of the bodies, may at last take place, through which the spine is rendered immovable and the distortion permanent.

Anterior curvature is, for the most part, limited to the lumbar region of the spine; the dorsal and sacral regions being implicated only so far that their normal curves become exaggerated. Occasionally, however, some few of the lower dorsal vertebræ may become involved, together with the lumbar curve; or, indeed, the entire dorsal curve may be reversed, and the anterior curvature will then consist of the lumbar vertebræ together with the dorsal. This is, necessarily, a very rare form of distortion, and it indicates great weakness of the muscles and ligaments of the spine. In an instance which I lately saw the sacrum was almost horizontal, and the head was forcibly thrown back.

*Treatment.*—It has already been said that lordosis is seldom a primary affection, but that it is the result of disease, or that it arises from the position of parts which are entirely independent of the lumbar region itself. This affection is for the most part developed in childhood. In childhood, however, the normal curves of the spine disappear in the horizontal position. Hence it is obvious that the recumbent posture must be in itself a powerful agent in the treatment of this form of curvature. Doubtless, whatever the cause of anterior curvature may be, the treatment should be followed whilst the child is recumbent; and the supine is the best position in which to place the child; for the shoulders can then be raised, whilst, in addition, the thighs may be flexed on the pelvis. In this manner an anterior spinal curve may at length be removed.

When this form of spinal curvature has been induced by rickets, it is especially important to observe the recumbent posture; for the upright position tends to increase the spinal curve, and will probably also occasion some distortion of the lower limbs.

Cases occur, however, in which it is not practicable to observe constantly the recumbent position, and it then becomes necessary to substitute for it a portable instrument, which, receiving the weight of the head and shoulders, transmits it to the pelvis. The spinal column is thus relieved, and the extensor muscles are less violently thrown into action. It is a very imperfect substitute, however, for the recumbent position.

# CHAPTER XVII.

## POSTERIOR CURVATURE OF THE SPINE.

POSTERIOR curvature of the spine is a much more common affection than that last mentioned. It occurs both in childhood and in old age; and, indeed, no age is exempt. In infancy, all the dorsal vertebræ are engaged in this curve; while in youth the middle and upper portions of the dorsal spine are especially implicated; and in old age the spine is most bowed in the upper dorsal region. In infancy, the muscular system is mainly affected; while later in life the skeleton becomes altered, and the intervertebral substances are compressed.

*Causes.*—The causes of posterior curvature of the spine are debility—whether in infancy, in youth, or in old age; rachitis, muscular rheumatism, and partial paralysis. Some occupations are prone to induce a stoop in those who are engaged in them; thus it is, for instance, with watchmakers, engravers, embroiderers, writers, shoemakers, and others, whose occupations require a stooping position. This position, which is at first most irksome, becomes at length easy, and more or less permanent. Those, also, who are subject to asthma acquire a stoop which becomes diagnostic of the disease.

Debility, especially in infancy, is the cause of posterior curvature. The curve, for the most part, occupies the entire length of the spine, from the occiput to the sacrum; and occurring in infancy, it is the least severe form of posterior curvature. The normal curves of the spine have not, as has already been explained, yet been formed, for the muscles of the back have not yet the power to support the trunk; and the head in consequence falls forward through muscular debility. This bowed condition of the spine increases, and the dorsal vertebræ become more prominent; for, notwithstanding its weakness, the child is seldom kept lying down. Nutrition is imperfect, and symptoms of rickets perhaps begin to show themselves; such as frequent diarrhœa, perspiration about the head and neck, general wasting, and a blanched condition of the skin. The child is uneasy and fretful. Swelling of the ends of the long bones may now be observed, especially of the carpal extremity of the radius and the tarsal end of the tibia; and the vertebræ will probably now assume a somewhat more prominent appearance.

Such children are seldom brought up at the mother's breast, or they are not alone nursed, but are fed at the same time with farinaceous food. Some are born rickety; others become so at the breast, when, at the same time, they are fed with farinaceous food; but a child which is healthy at birth will seldom show symptoms of rickets while it has a sufficiency of milk for nutrition (and without admixture of farinaceous food), and while it is kept warm.

When the child has commenced to walk, a different kind of curve is, for the most part, induced. Here the normal antero-posterior curves have been at least in part developed, that the erect position may be maintained, and consequently, as in the last-mentioned form of distortion, the curve which is induced is an exaggeration merely of the normal curve of the region. It occupies especially the middle or the middle and upper portions of the dorsal region, as is shown in Fig. 60.

FIG. 60.

Occasionally, posterior curvature resembles angular curvature of the spine so closely as to be mistaken for it. In the instance from which Fig. 61 was taken a rachitic tendency was hereditary; and consequent on this condition, excessive distortion was induced, such, indeed, as I never saw equalled.

Fig. 61.

In *youth* posterior curvature often occurs during rapid growth, as a consequence of debility. At this period the lower cervical and upper dorsal vertebræ are mostly affected. A stoop is not unfrequently acquired during convalescence, which may remain

permanent in manhood. Those also who are short-sighted, and who do not habitually wear glasses, are apt to accommodate their figures to their imperfect vision, and thus they acquire a stooping position. Posterior curvature is not attended with tenderness in the course of the spine, so that firm pressure may be made along the spine without causing pain. Should, however, tenderness be found on examining the spine, destructive disease, or caries, must be suspected. And, indeed, caries is often so insidious in its advances, that great and irremediable distortion may have already taken place before the affection is recognised.

In *old age* an abnormal increase of the dorsal curve is common, as a result of muscular debility. And this is also the case when posterior curvature has been induced by any occupation, or through disease, as rheumatism, &c.; it is then not unfrequently greatly increased in old age. Under these circumstances, equilibrium cannot be maintained, and a stick becomes necessary for support.

*Pathological Anatomy.*—The pathological appearances differ according to the age at which posterior curvature is observed. In infancy the muscular system is chiefly affected; while in the adult the intervertebral substances become compressed anteriorly; and in old age fusion of the bodies of the vertebræ, or more partial ossification, may be found. Together with these changes, the whole trunk is more or less affected; the chin rests on the sternum, the ribs are approximated, and respiration is laboured in consequence of their diminished motion.

*Treatment.*—In childhood the horizontal position should be observed until the curve is removed. Then, as strength is gained, means may be taken to develop muscular power; and in proportion to its development, so the antero-posterior curves of the spine become formed, and the erect position can be maintained. In more advanced age, mechanical support is necessary to redress the bent spine or to assist nature.

## CHAPTER XVIII.

### LATERAL CURVATURE OF THE SPINE.

LATERAL curvature of the spine is that form of distortion in which the vertebræ deviate in a lateral direction from the mesial line of the trunk. This affection may be divided into two stages, or periods; namely, first, *incipient curvature;* and secondly, *confirmed lateral curvature.*

By incipient curvature is understood such a condition of lateral deviation of the spine as is removable in the recumbent position, with the help perhaps of some slight pressure; while a confirmed curve requires the application and long continuance of mechanical means for its removal.

Lateral curvature is the most common form of spinal curvature. It occurs more frequently in the female than in the male sex; it seldom commences after the age of puberty, and it does not commonly occur as a primary affection.

*Causes.*—The principal predisposing causes of lateral curvature are debility—muscular or constitutional, acquired or inherited—and rickets; and the exciting or proximate causes are bad habits of sitting or standing,—such as sitting for prolonged periods in a constrained attitude, as is often assumed in drawing or in writing, and, as frequently happens

in schools, when the back is not supported and the muscular strength is insufficient to enable the child to sit upright; the pelvis and trunk are then inclined to one side or the other to obtain temporary relief. But the most common cause of lateral curvature is the habit of standing, more or less, on one leg. This habit is indulged in to a very great extent by young girls, to gain relief either in consequence of some local weakness or from fatigue; for weariness is readily induced during the period of growth, and especially when growth is rapid. This attitude causes the hip to become prominent, and the pelvis to be inclined towards the opposite side. Together with this obliquity of the pelvis, the spine also becomes curved. At first the curve is temporary, and is removed in the recumbent position; but at length, as the obliquity of the pelvis becomes permanent, so the curve also becomes confirmed; and thus the equilibrium of the trunk is disturbed. Equilibrium is restored by means of secondary or compensating curves; and these are formed in a regular series, and are determined by the position of the primary curve.

Debility, then, is the chief predisposing cause of lateral curvature of the spine; and the most frequent exciting cause is obliquity of the pelvis, which is induced by bad habits of sitting or standing. But although these are the chief causes of obliquity of the pelvis and lumbar curvature, yet others exist: for whatever may act mechanically in disturbing the equilibrium of the body will induce spinal curvature. Thus inequality in the length of the lower limbs, whether produced by a bent tibia or femur, by flat-

foot or knock-knee, by muscular contraction, articular disease or partial loss of muscular power, will induce obliquity of the pelvis and a primary lumbar curve.

Take, for instance, the case of a child whose health is delicate from whatever cause. If it be treated in the same manner as a stronger companion, some irregularity of form will probably develope itself; but the particular form of distortion will depend mainly on the habits of the child. Thus, if the child stand or walk much, probably the internal lateral ligament of the knee-joint will yield, and give rise to genu valgum; and this distortion will probably be followed by yielding of the ligaments of the ankle-joint, and of those in the sole of the foot, and thus flat-foot is induced. Suppose, again, that in consequence of resting too much on one leg, as is very common with such children, the ligaments of that limb have yielded more than those of the other limb. That extremity becomes by so much shorter than the other; and therefore, when both feet rest on the ground, the pelvis necessarily becomes oblique to accommodate itself to the difference in the length of the extremities. But an oblique pelvis must give rise to spinal curvature.

Fig. 62 was taken from such a case.

The child was 12 years of age, and she habitually stood on the right leg.

The prominent features of this case may be thus described. There was genu valgum on the right side; the right side of the pelvis was, in consequence, lower than the left, and this gave rise to a right lumbar curve, which was followed by a compensating

left dorsal curve. It followed as a consequence of these curves that the right shoulder was three fourths of an inch lower than the left, and the right side of the pelvis was half an inch lower than the left side.

Again, Fig. 63 was taken from a young person, sixteen years of age, who, from overgrowth, had become

FIG. 62.

feeble. The spinal distortion had been four years in forming. She habitually stood on the right leg.

Both of these distortions, which are here represented in Figs. 62 and 63, are due to debility. In the first, the internal lateral ligament of the knee-joint having yielded, genu valgum was induced,

and the pelvis was inclined towards the same side. Then, as a necessary consequence, spinal curves—a primary lumbar and a consecutive dorsal curve—were formed. While in the second, Fig. 63, from constantly standing on one leg the pelvis became oblique, falling towards the opposite side, as is well

FIG. 63.

shown, and a lumbar curve was necessarily produced with its convexity towards the lowest ilium. This distortion was not in the first instance constant, for it could be removed when the patient was lying down. It was an incipient curvature which required

time and the continuance of a bad habit to make it a permanent curve. But it required a short time only to effect this purpose; for when I again saw this patient after an interval of some few months, there was produced the condition which is represented: the primary curve had become permanent, and had given rise to a secondary or dorsal curve. The existence of the secondary curve is a proof of the permanent character of the primary curve; for while the primary curve is incipient only, or removable in the horizontal posture, the secondary curve does not form; but the compensating curve begins to form so soon as the primary curve becomes in the slightest degree permanent.

Those who are feeble, whether from overgrowth or during convalescence, constantly change their position while standing; so that they rest for a short time only in one position and change it for another—from both feet to one foot, for instance, and back again. And it is found that it is habitually the right foot in some cases, and in others the left foot, which has, in this way, to bear very frequently almost the entire weight of the body, until, at length, it becomes more natural to stand on one leg only, than fairly on both. It becomes so natural to do this, that it is done unconsciously; and until it is pointed out, the patient is frequently not aware of the habit. This occurred, and it was frequently pointed out, in the case from which Fig. 63 was taken.

Debility alone does not usually give rise to lateral curvature of the spine; but there must be superdded bad habits of standing or sitting, which shall

occasion obliquity of the pelvis and a primary lumbar curve. These habits to which I have alluded depend on debility, however; and therefore it is right to speak of debility as the cause of these deformities. But without obliquity of the pelvis, and therefore without bad habits of sitting or standing having been formed, lateral curvature of the spine may be occasioned by general debility. It may commence as a dorsal curve. This happened in the instance from which the following figure (Fig. 64) was taken. This is a form of curvature which commonly begins during convalescence; and commencing as a dorsal curve, it shows that it does not depend primarily on obliquity of the pelvis, nor on any affection of the lower extremities.

Every distortion is produced by a special cause; and it need scarcely be said that while the cause of curvature remains, the curve itself cannot be removed, or if it should be temporarily removed, it will certainly recur, inasmuch as the cause which first occasioned it still exists. It is of the utmost importance, therefore, in the treatment of spinal curvatures to ascertain precisely what may have been the exciting cause of deformity before commencing the treatment. But this primary investigation is unfortunately greatly neglected, and its importance is not generally understood; so that with many the treatment of spinal curvature is simply to apply a spinal instrument, without reference to the cause of curvature.*

It is well known that the muscles of the back of

* Vide Lectures by Mr. Cæsar Hawkins, 'London Medical Gazette,' vol. xxxviii, p. 311, 1846.

those who wear stays are not red and firm, but that they are, for the most part, pale and weak. Few will doubt that the constriction to which the figure is thus subjected conduces, through insufficient muscular development, to the formation of curvatures of the spine. It will, perhaps, be said, however, that

Fig. 64.

debility of the muscles of the trunk being induced equally on both sides, there is no reason why lateral curvature of the spine should follow. It should be remembered, however, that the causes which act on the spine to induce curvature operate with increased

force when the power of the muscles of the back is diminished.

Again, another series of causes exists which induce spinal curvature—namely, such as alter inordinately the relative power of the upper limbs. Thus the

FIG. 65.

power may be increased or diminished—increased by extraordinary use, as through carrying a burden on one arm, or as occurs in certain trades, where one arm is much more employed than the other; and thus it is found that nurses, needlewomen, tailors, shoemakers, compositors, and some others

are unusually liable to affections of this kind. And when muscular power is diminished, as through paralysis, partial or complete, of an upper extremity, or by amputation, lateral distortion of the spine occurs in the dorsal region, with the convexity of the curve towards the more powerful muscles. (See Figs. 65 and 66.) Some of the causes above enu-

FIG. 66.

merated are in themselves sufficient to induce spinal curvature; but this effect is produced both more rapidly and with more certainty when there is a condition of general debility present, whether as in

convalescence or through overgrowth, or through insufficient food and overwork, than in health.

Rickets is another cause of lateral curvature of the spine. This, however, is a general disease which involves not the bones only, but every tissue of the frame. It is sometimes hereditary; but much more frequently it is developed after birth, through exposure to cold and through insufficient or improper food. Diarrhœa is established, and it is followed by wasting and pallor, and subsequently by swellings of the ends of the long bones. The whole skeleton may become more or less softened, and then the bones become curved through mechanical causes. Especially the lower limbs become curved, whereby the pelvis is rendered oblique, and spinal curvature is induced. In this form of disease, not only is spinal curvature induced at an earlier age than when it arises from debility, but it is of an infinitely more severe form. In the case from which Fig. 67 was taken, rickets was first developed at eight years of age, and the child was thirteen years old when the drawing was made. The lower limbs first became bent; then the pelvis was tilted to one side and was flattened, and immediately afterwards the spine became curved. Distortion is never so great in childhood, from any other cause as when it is induced by this form of disease.

This rickety condition of the spine is sometimes, though rarely, developed without the long bones being affected. There will then probably be seen also rickety deformity of the ribs and of the sternum.

Also, there is a form of curvature which is transmitted with a strumous diathesis, and which per-

vades certain families. I know families, almost every member of which, in perhaps two generations, has been thus afflicted — some severely, others slightly; but all, or nearly all, have been affected

FIG. 67.

with spinal curvature. In more than one instance I have had reason to believe that this affection had its origin in the excessive exhibition of mercury. In whatever manner it may be induced, however,

such disease is generated in these cases as occasions both constitutional and muscular debility.

There are still two other very rare varieties of lateral curvature to which it is only necessary to allude—viz., curvatures arising from malformations of the vertebræ, and from effusion into the cavity of the thorax. In the former there is occasionally seen, either a deficient development, or an excess of development in the lateral halves of some of the bodies, and indeed of other portions of the vertebræ. There is a remarkable example of this malformation in the museum at Vienna, which I lately examined, and which consists of four half-vertebræ, with their half-arches and processes in excess.* These occasioned curvature of the sacrum, slight curvature in the lumbar and lower dorsal regions, considerable curvature in the middle dorsal region, and also a considerable curve in the upper dorsal region.

Effusion into the cavity of the thorax, and which is followed by collapse of one side, is subsequently compensated by enlargement of the opposite side. After the effused fluid has been removed from the pleural cavity, the ribs sink to the compressed lung, the lung itself being bound down by adventitious membranes, so that it cannot expand. Thus, the side becomes flattened and the lung remains contracted. Compensation afterwards follows, through amplification of the sound lung and enlargement of its containing cavity taking place. When it arises from this cause the curve occupies the entire dorsal region. Its appearance is shown in fig. 68.

* Vide Rokitansky's 'Pathological Anatomy,' Sydenham Society's edition, vol. iii, p. 228.

FIG. 68.

MODES OF FORMATION OF SPINAL CURVES.

From what has already been said, it will be understood that when a cause acts mechanically from below and produces obliquity of the pelvis, it must in the first instance give rise to a lumbar curve, just as wry-neck will first occasion a cervical curve. And as the causes which act from below upon the spine are both more varied and more frequently met with than those which affect the upper extremities or the neck, it is found that spinal curvature commences much more frequently in the lumbar than in the dorsal or cervical regions.

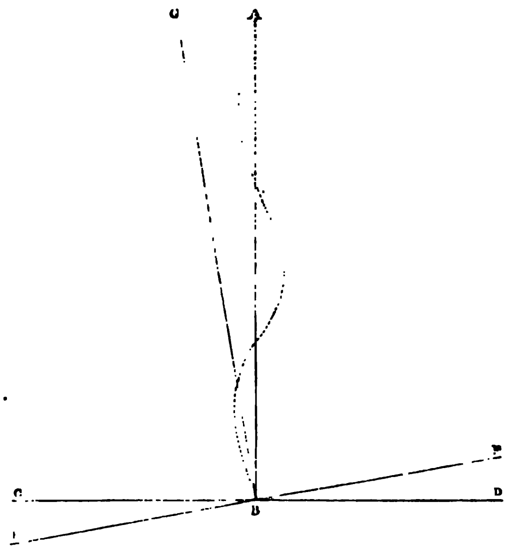
In the upper classes, amongst whom lateral curvature is common, it is the rule that the lumbar curve is first formed; while in the labouring classes, who use their hands and arms much, in carrying burdens and in other manual labour, the dorsal curve is very frequently first developed. A spinal curve cannot, however, remain single except in the horizontal posture; but, that the equilibrium of the body may be restored, a second or compensating curve must be formed, otherwise the erect position cannot be maintained. But a primary curve is never entirely compensated by a secondary curve, and therefore other curves form above and below it. Thus a dorsal curve is always followed by others—one above as well as one below it; and a severe lumbar curve not only occasions a dorsal but also a sacral curve. One curve runs into the other, so that as one forms another is forming.

Thus a primary curve may be lumbar, dorsal or cervical, and the position of the primary curve is determined by the exciting cause of distortion; while compensation takes place through the formation of secondary curves, which are produced by the muscular effort to maintain the erect position. These curves are always undergoing change, and becoming more rigid and compressed, until at length the height of the trunk may be considerably diminished.

Perhaps the modes in which spinal curves are formed will be more readily understood by means of the following diagrams (Fig. 69 and 70).

Suppose the lines A, B, C, D to represent the pelvis and the spinal column in their normal relations;

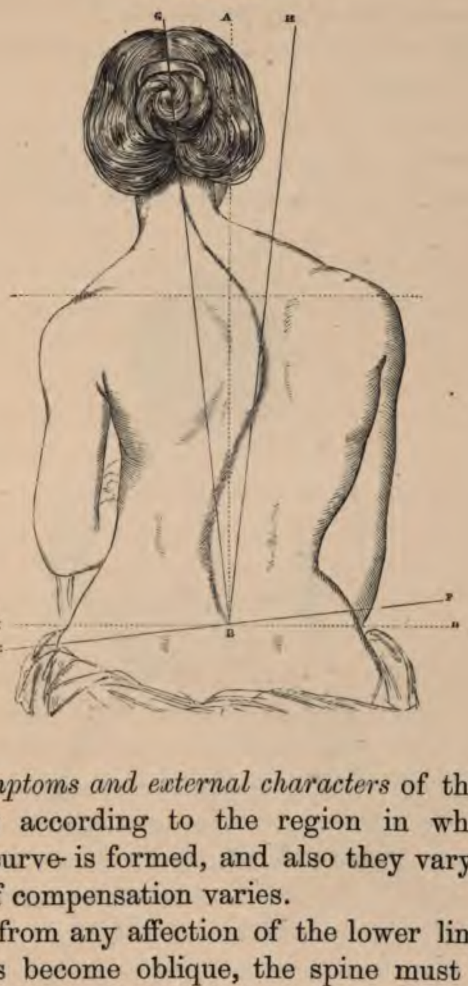
FIG. 69.




namely, the spinal column forming a right angle together with the pelvis; and let E F represent the pelvis rendered oblique, from whatever cause; and G B the inclined column still forming a right angle with its base. How is equilibrium to be maintained? It is manifest that the line G B, if continued, would render equilibrium impossible; and, therefore, a series of curves about the perpendicular line A B are formed to maintain equilibrium, as is better shown in the following figure.

It will be seen, however, in Fig. 70, that the cervical curve corresponds to the line G B. And such must, indeed, more or less, be the case until equilibrium is restored through increase of the spinal curves: then the cervical curve approaches the perpendicular line, as is shown in Figs. 69 and 71.

FIG. 70.



*The symptoms and external characters* of this affection vary according to the region in which the primary curve is formed, and also they vary as the amount of compensation varies.

When, from any affection of the lower limbs, the pelvis has become oblique, the spine must become curved in the lumbar region; and from the concurrence of these two conditions—namely, the depression of the ilium on the side of the lumbar convexity, and the loin falling in through the recession of the lumbar vertebræ in the formation of the lumbar curve—the

hip becomes prominent. This is a constant, and one of the most striking symptoms which is observed, and it may always be seen even before a secondary dorsal curve is formed.

Again, when spinal curvature commences in the dorsal region, or when a compensatory curve has been formed in this region, the shoulders are not

FIG. 71.

placed on the same level—one is raised while the other is depressed, and the scapula becomes unduly prominent on the convexity of the dorsal curve. The shoulder is popularly said to be "growing out." This increased prominence of the shoulder is due,

in part, to the increased angularity of the ribs, and in part also to muscular action. In the formation of the lateral curve the vertebræ become somewhat twisted or rotated, and consequently the angles of the ribs on the convexity of the curve project abnormally, while the ribs themselves are rendered more horizontal in their direction, and are more widely separated from each other than in their normal condition; but on the side of the concavity the ribs become oblique and are depressed, so as to lie one upon another, or even to overlap one another. The flattening of the front of the chest is also remarkable. On the side corresponding to the concavity of the spinal curve the ribs become, however, unduly prominent at the lower part of the thorax, and thus the greatest diameter of the chest, in an advanced case of dorsal curvature, is in an oblique direction from behind forwards.

*Pathological Anatomy.*—The pathological conditions which result from lateral curvature of the spine may be divided into those effects which are produced immediately upon the spine and trunk, and those which are consequent upon these changes.

Confirmed lateral curvature is not purely a lateral deviation; for so soon as the curves become more or less permanent, the vertebræ which are involved in them become rotated on their axes in such a manner that the anterior surfaces of the bodies of the vertebræ occupy the convexities of the curves, and consequently present more or less laterally. In a severe case, such as that from which Fig. 72 was taken, the anterior surfaces of the bodies of the

vertebræ have undergone such an amount of rotation that they have acquired a lateral instead of their normal direction, and occupy the greatest convexities of the curves. But although the bodies of the vertebræ may have become thus rotated, the

Fig. 72.

spinous processes may perhaps undergo only slight change, so as scarcely to indicate a lateral curve. These points are well shown in Figs. 73 and 74, especially in the dorsal curve, which, if traced by a

novice, would scarcely be recognised as a spinal curve, although the bodies of the vertebræ are rotated to the extent of nearly a quarter of a circle.

Fig. 73.

Fig. 74.

Perhaps, however, the course of the spinous processes in the lumbar portion of the spine is even

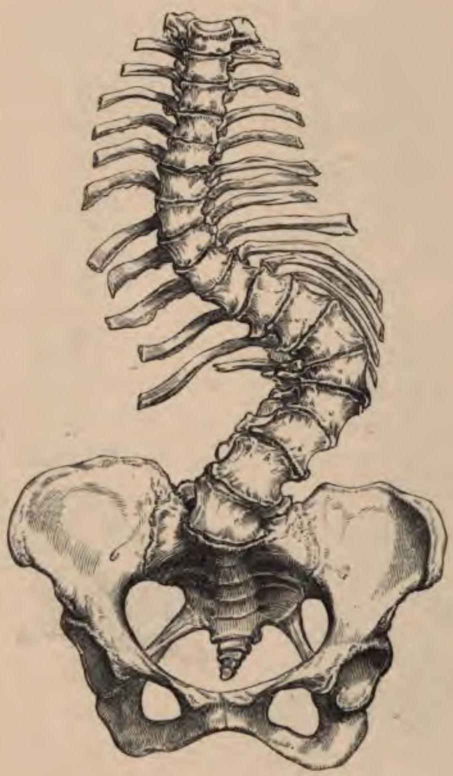
more remarkable, considering the greater rotation which has taken place in this portion of the spine—rotation equal to one fourth of a circle. Thus it is that a spiral twist of the spinal column may exist to a very great extent, through rotation of the bodies of the vertebræ, without the apices of the spinous processes describing a corresponding curve. It is important to remember this circumstance; for many become hopelessly deformed, because the mode in which spinal curves are formed is not rightly understood, and because measures are not taken in the commencement of the deformity to remove the spinal curve.

While a lateral deviation of the spine is incipient only, the intervertebral cartilages become compressed laterally, and they recover their form when the superincumbent pressure is removed; just as is well known to occur in health, when a man of ordinary stature, who has been in an upright position during the whole day, loses three fourths of an inch in height, through the compression which takes place of the intervertebral substances, and which he regains only after some hours spent in a recumbent posture.

When, however, these intervertebral substances become unequally compressed, and this effect is continued from day to day, they lose in a measure their elasticity, and do not recover their full form during the period of repose, but remain somewhat compressed and wedge-shaped. Curvature is then permanent, and rotation of the bodies of the vertebræ commences. The bodies of the vertebræ are not all in the same measure rotated; but those are

most rotated which are nearest to the centre of the curve, and that vertebra which is central is most rotated and most wedge-shaped. This is shown in Fig. 75, where the vertebra in the centre of the

Fig. 75.



lumbar curve is represented as rotated to the extent of one fourth of a circle, and wedge-shaped, while those above and below are both less rotated and less wedge-shaped. And in the same manner the

intervertebral substances which enter into the curve are reduced in thickness.

In contrast with these are Figs. 76 and 77, from an

FIG. 76.

FIG. 77.

articulated spine, where the anterior and the posterior surfaces agree perfectly, and where the vertebræ are piled one above another with great care after the fancy of the constructor, but unfortunately without the slightest regard for truth. Such is the

manner in which articulated spines are invariably put together. There is not, in the museum of the College of Surgeons even, an articulated spine where the characters of the distortion are preserved. It is only fair to say, however, that the vertebræ having been taken asunder and the intervertebral cartilages removed, it is no ordinary puzzle to put the several parts together again as they had grown.

In the figures above (72, 73, 74, 75) it will be seen how the bodies of the vertebræ are rotated towards the convexity of the curve, and how in the concavity the bodies, through pressure, become wedge-shaped; that vertebra which is the most central being also the most compressed: it may lose more than half of its thickness. It will further be seen that the spinous processes are not curved in the same manner as the bodies of the vertebræ; and that even in the lumbar region they may scarcely be removed from the middle line of the trunk, while the bodies themselves are immensely curved. Through pressure, the cancellous structure of the vertebræ becomes somewhat consolidated, and the outer surface of the bone is thickened and rendered more dense.

The mode in which curved spines are articulated in our museums tends to perpetuate an error. It is true that this spiral twist of the spinal column has been alluded to by several authors, but it is not understood that spinal curvature can exist without the apices of the spinous processes also describing a curve. Thus, many become hopelessly deformed through inattention to commencing dis-

tortion, and through want of knowledge with regard to the manner in which spinal curves are formed.

This unequal pressure, which is caused by rotation, produces at length partial absorption of the intervertebral cartilages, as well as of the bodies of the vertebræ.

It is clear, from the previous statements, that, in defining a spinal curve, we should not be too rigidly guided in our judgment by the line of the spinous processes; but that the condition of the entire trunk should be considered. The line of the spinous processes is often such that, if it alone were considered, the diagnosis as well as the prognosis of the affection must be incorrect.

The *transverse processes* of the lumbar vertebræ on the side of the convexity of the curve are rendered prominent, causing the erector spinæ to project; while, on the opposite side, the processes cannot be felt. And through rotation of the vertebræ, the articulating processes become partially absorbed by undue pressure, and their articular facets are lengthened.

These changes in form of the vertebræ during the development of a lateral spinal curve are very remarkable; but the most striking change which takes place in relation to spinal curvature is that which is effected in the shape of the thorax. The ribs necessarily follow the altered positions of the vertebræ to which they are attached, and undergo a movement of rotation backwards on the convex side of the curve, so that their angles are rendered more prominent, and they become more horizontal in their direction, while the intercostal spaces become wider

than in their normal state; but on the concave side of the curve the ribs sink and become flattened, the intercostal spaces also become more or less effaced through overlapping of the ribs, and the ribs are carried forward, and become prominent on the anterior and lower part of the chest. On both sides of the chest the ribs are flattened; but on the convex side of the curve, in consequence of the rotation of the vertebræ into the convexity and the flattening of the ribs, the lung is much compressed. Through these changes in the form of the thorax and others which are coincident with them, the capacity of the chest is diminished. Also the appearance of distortion is much increased by the prominence of the scapula. On the convex side of the curve this bone is thrust up, and is placed obliquely, through the increased angularity of the ribs, and it is still further raised by muscular action.

The pelvis is not materially affected in an ordinary case of lateral curvature of the spine. It becomes oblique, as has been already observed; and when the superincumbent weight is unequally transmitted to the ground, it becomes slightly flattened. When, however, the pelvis is affected with rickets, it becomes flattened from above downwards, both by the superincumbent weight and by the resistance of the lower limbs; so that the space between the promontory of the sacrum and the symphysis of the pubes is diminished. A case of this description is on record, where it was necessary to perform the Cæsarean section, for the pelvis was so much deformed that a ball of one inch in diameter would not pass through the brim.

In the second place I will proceed to examine, cursorily, the result of these changes on the thoracic viscera, as well as those which take place in the structures which are attached to the trunk itself.

The thoracic space, on the convex side of the curve, is diminished by the flattening of the ribs, and by the rotation of the bodies of the vertebræ; and the heart is consequently somewhat displaced towards the concave side of the curve. Respiration is considerably affected; and in consequence of the imperfect expansion of the chest and lungs, the right side of the heart becomes dilated, and the blood is insufficiently aërated.

The aorta follows the inflections of the vertebræ in spinal curvature. It is bound down to the spine by its branches, and, therefore, always follows the curves of the spine. Its course, under these circumstances, is well shown in a preparation numbered 3416 in the museum of the Royal College of Surgeons. In a practical point of view, this course of the aorta may appear to be a matter of only small importance. It deserves to be remembered, however; for in a thin person, with the convexity of the lumbar curve towards the right side, the aorta may be felt immediately under the finger, lying out of its normal course, and on the right side of the umbilicus. I have known the pulsation of the artery under these circumstances to suggest ideas of aneurism.

Together with severe lumbar curvature, there is always found obliquity of the pelvis. This obliquity of the pelvis is not a simple tilting to one side (one side being raised while the other is depressed), but there is at the same time a slight movement of rota-

tion of the pelvis itself—which, indeed, is necessitated by the circumstance of the lumbar curve and the rotation of the lumbar vertebræ; so that the anterior superior spinous process of the ilium is not only raised above that of the opposite side, but it is also in advance of it. In the female this obliquity is of less importance than in the male; but in the male the triangular ligament of the urethra, together with the rest of the pelvis, being twisted, the direct course of the urethra behind the ligament no longer corresponds with that in front of it. This twisted condition of the urethra may cause an impediment to the introduction of a catheter into the bladder. This should always be borne in mind when stricture of the urethra exists in such a case. I have known more than one instance where, without the knowledge of this fact, it had been found impossible to introduce either a metallic or an elastic catheter into the bladder. Whenever in cases of severe lumbar curvature it is necessary to use an elastic catheter, this is always withdrawn moulded into a sigmoid curve, similar to the urethral curve.

*Treatment.*—The treatment of lateral curvature of the spine can only be undertaken with advantage when the cause of the curvature is known, and also when the order in which the various curves of the spinal column have been formed is fully understood.

It must be obvious to all who reflect on the subject that it is useless to endeavour to remove a spinal curve whilst the cause of curvature yet remains; for, even should the curve be removed, it will recur so soon as the means which were adopted to remove it are discontinued; and the same cause will

again affect and distort the spinal column as before. Thus, for instance, suppose that some affection of the lower limbs has occasioned obliquity of the pelvis, a primary lumbar curve and a compensating dorsal curve. The treatment which was formerly adopted was, without reference to the cause of curvature, to make pressure on the convexity of the dorsal curve. This mode of treatment was not only useless, but it was positively injurious: it increased the lumbar curve, and flattened still more the flattened ribs.

The course of treatment which should be adopted is, first, to remove the cause of the obliquity of the pelvis, whatever this may be; and whether it be some affection of the foot, knee, or hip, this should be treated and removed, if not before, at least at the same time as the lumbar curve is being treated. Again, when the dorsal is the primary curve, it may be treated by means of a portable instrument, while the lumbar curve is supported by another portion of the same instrument.

The treatment of spinal curvature should be undertaken so soon as the slightest distortion is perceived. It is difficult to remove a spinal curve at any time; and it is especially difficult to effect this when the disposition to curvature is inherited. Spinal curvature can then only be removed when mechanical means are rightly directed to this end. It was with good reason that Sir Benjamin Brodie said, "The treatment of the disease cannot be begun too soon after the first signs of spinal curvature are perceptible."*

A slight curvature of the spine is by some con-

* Lectures on 'Distortion of the Spine not connected with Caries.'

sidered to be a matter of such trivial importance as to be unworthy of attention. It is a very serious error to offer such advice, however, and in later years it must cause much distress. However trivial spinal curvature may appear in the commencement, its course is necessarily to produce increasing deformity, with more or less pain and impairment of the general health. So little are the laws of equilibrium understood, that it is imagined by some that a wry-neck, or a "growing out" shoulder, or an oblique pelvis, is an affair of small importance, and that distortion will probably not increase beyond that which is at the time observed. Some even are bold enough to imagine that a child will "grow out" of these distortions. These are delusions, however, which observation quickly dispels. When curvature of the spine, from whatever cause, has commenced, it must go on increasing until, by the formation of compensating curves, the equilibrium of the body is restored.

Having explained how pathological spinal curves are formed, and how they are compensated, so that the equilibrium of the body may be restored, I will proceed to consider the application of mechanical means to the removal of spinal curves.

So long as a spinal curve is incipient, it may not be necessary to have recourse to mechanical support to the spine itself; but it may be sufficient to remove the exciting cause of distortion, and to develop the muscular system by means of well-directed exercises. When, however, these measures are found insufficient, support should be applied to the spine itself without more delay.

If it be a fact that one curve is first formed, and

that others are subsequently formed as compensatory of this primary curve—and no one can doubt it who has watched these cases attentively—then it should follow that treatment must in the first instance be directed especially to the removal of this primary curve; for to endeavour to remove a secondary curve without giving efficient support to the primary curve is the most certain mode that could be devised of increasing the original curve. Having determined, then, which is the primary curve, pressure should be made (not on the greatest convexity of the dorsal curve, to flatten still more the ribs and render the sternum prominent) in that direction which shall tend to restore the positions of the ribs, and which shall also restore those vertebræ which have undergone some rotation to their normal positions. This is most effectively done by applying the force to be used to the lower arc of the curve, both of the primary and of the secondary curve, in those instances where the curves are formed from below upwards; but when the curves are formed from above downwards the lower arc of the dorsal curve and the upper arc of the lumbar curve should be supported. When the combined forces of a well-adapted instrument are made to act in the directions now indicated—namely, obliquely towards the centre, they tend to unbend the primary curve. The movement which is thus commenced in the primary curve is often greatly assisted by muscular action on the compensating curve. In this manner the several curves are at the same time acted on and unfolded.

This pressure should, as much as possible, be made to follow the course of deviation of the parts

themselves; and, consequently, it should never be directly lateral. By using extension in the manner indicated, curves, which cannot otherwise be treated, may be unfolded. This unfolding process is slow; and this will not excite surprise, when it is remembered what are the pathological changes which have taken place. Rapid effects are impossible, and should not be expected.

But the time which is necessary for the completion of this unfolding process depends on the degree of fixity of the curve and on the ability to bear the treatment. Some patients never shrink from the support which is afforded by a well-fitting instrument, while others cannot bear effective pressure. Among the latter are those who suffer from rickets. Again, some cases are necessarily incurable, and they must be recognised as being in this category from the beginning; such as those which are produced by inflammation and its results within the thorax or which arise from congenital malformation, and also those again where ankylosis has taken place, whether in angular or in lateral curvature; for in the former a slight lateral curve not unfrequently forms above and below an irregular union, and in the latter, bands or bosses of bony matter are sometimes thrown out, which unite two or more vertebræ.

Spinal instruments may be portable, or they may be fixed to a couch. When they are to be worn as portable instruments, they should be made as light as possible consistently with strength and utility.

When the general principle of construction is understood, the apparatus may be variously modified so as to act with the greatest advantage on the distortion, whatever it may be. The pelvic band

and lateral supports to receive the weight of the shoulders are always necessary; to which may be added two levers, which may carry a shoulder-sling to act on a cervical curve, and a plate for the dorsal curve; or it may be required to act on the dorsal and the lumbar curves at the same time, or even to increase the force of the dorsal plate by acting with a separate plate on the pelvis itself. The levers, or the plates themselves, may be provided with single or compound movements. By these means not only can the apparatus be adjusted very perfectly, and be made to fit with great nicety, but the power to overcome distortion is at the same time increased.

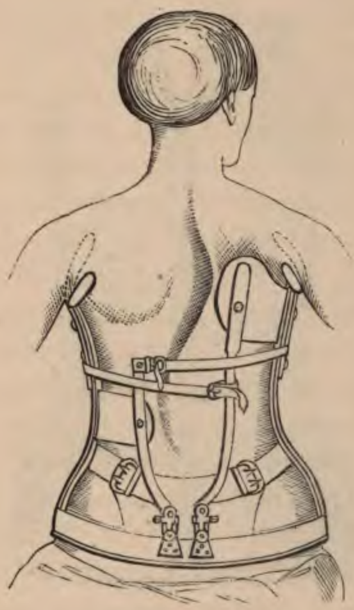
Further, by means of adjustments the positions of the plates may be altered as the spinal curves are opened; and since the curves of the plates correspond in some measure to the curves of the ribs, and their obliquity is similar to that of the thorax itself, adjustment does not cause pressure directly in a lateral direction, but it occasions upward and downward pressure according to the nature and position of the curve to be acted on.

When the instrument fits well, frequent changes are unnecessary; and without it fits well it is useless. Great pressure is never required, and it may even be hurtful. Modifications, however, are necessary from time to time, to keep up the action of the instrument, and to vary the pressure as the curves unfold.

The forms of spinal instrument which are usually required are shown in Figs. 78 and 79. These necessarily vary, as the deformity to be treated is more or less complicated.

In the treatment of these affections the patient should frequently recline in a spinal chair during the day; and the spinal support will then be worn both with comfort and advantage during the whole day. But, although it is important that the spine should be well and efficiently supported, it is unnecessary

FIG. 78.



that an apparatus should be worn at night. The restraint of an apparatus at night is injurious to health, and the instrument can seldom be worn so effectively that the body during sleep shall not be twisted in it.

But, without doubt, the most effectual mode of treating spinal curvature is on the spinal couch. In the recumbent posture the weight of the body is entirely

removed from the spine, and the means to be employed, therefore, are necessarily much more efficient to remove distortion than when portable instruments alone are used. Not only is the recumbent position most favorable for the action of the instrument, but

Fig. 79.

the instrument itself, when attached to the couch, is infinitely more powerful to remove spinal curvature than any portable instrument can possibly be. The principle on which both of these instruments are constructed is similar; but the couch, acting with powerful machinery, instead of by a slight cog-and-pinion movement only, is so powerful to effect the purpose in view, that it will remove distortion in cases where

the portable instrument is utterly useless. In cases of severe distortion, I always recommend the combined use of the couch and the portable instrument, the employment of one alternating with that of the other.

When spinal curvature has been produced by a local cause, or by an acquired habit, the cause must be removed, and the habit must be overcome; without which it is impossible to treat this distortion effectively.

After curvature has been removed, attention should be directed to the development of power by means of exercises which may bring into action the muscles of the trunk and extremities; such as swinging, dancing, riding, swimming, and the like. These exercises, alternating with rest, will, if judiciously employed, rapidly produce a marked increase of muscular power, as well as improvement in the general health. Friction also, as in shampooing, is very useful, not only in gaining a better condition of the skin, but it conduces to that suppleness of body which, after the removal of spinal curvature, is important to acquire.

It is scarcely necessary to say that it is of the utmost importance to attend to the general health in the class of cases now under consideration, for constitutional treatment is especially needed where there is debility, and debility is the principal predisposing cause of spinal curvature. At the same time, therefore, that mechanical treatment is undertaken in order to remove deformity, constitutional treatment should, so far as is possible, be made conducive to the restoration of health.

# CHAPTER XIX.

## WRY-NECK.

Torticollis, or wry-neck, occurs both as a congenital and as a non-congenital affection. It is not common as a congenital affection; but it is met with not unfrequently in children from two to twelve years of age; and, indeed, it may be seen at any period until middle life.

Wry-neck is occasioned by shortening of the cervical muscles, especially the sterno-mastoid muscle, through which the head is drawn to one side, the ear being approximated to the shoulder, and the chin projected in the opposite direction. Not only is the sterno-mastoid muscle contracted, but the trapezius and the scaleni become in a similar manner subsequently affected; and thus the shoulder is raised towards the head, while the head is drawn down towards the shoulder. In this manner a cervical curve is produced, which presents its concavity towards the retracted muscles, and which is followed by a dorsal curve—as has been already explained, when wry-neck was spoken of as a cause of spinal curvature.

One or both insertions of the sterno-mastoid muscle may be retracted; and this is especially the case in congenital wry-neck. On the other hand,

the whole muscle may be retracted, as occurs, for the most part, when the deformity is a non-congenital affection.

Wry-neck produces singular changes in the features. The angle of the mouth is depressed, and the cleft of the eyelids is drawn on to a lower level than on the opposite side; the eyebrow, too, is drawn down, and the side of the face appears to be smaller and less developed than on the opposite side—it is motionless and without expression, while the features on the other side of the face appear to be unnaturally expanded.

When wry-neck is allowed to proceed unchecked, and without any attempt being made to prevent further retraction, deformity results both of the neck and of the spinal column, which may attain to serious proportions.

*Treatment.*—It is with wry-neck as with some other cases of deformity, that, when discovered and treated at an early period, mechanical means may be sufficient to overcome such distortion as is occasioned by slight muscular retraction. It is, however, rare that extension can be so effectively and continuously employed as to overcome and remove even slight deformity which depends on muscular retraction. And it is preferable to proceed to the subcutaneous section of the tendons of the retracted muscles rather than much time should be lost in futile attempts at extension.

As in the case of F. S—, in Princess's ward of St. George's Hospital, from whom Fig. 80 was taken, it is sometimes alone necessary to divide the clavicular

insertion; while, again, as in another instance in the same ward, the sternal attachment of the sterno-mastoid muscle alone required division. For the most part, however, both the sternal and the clavicular insertions of the muscle should be divided.

When it is required to divide both the sternal and the clavicular portions of the muscle, separate punctures should be made, so that the blade of the knife may be kept closely in contact with each portion of tendon. The punctures may be made most conveniently about one inch above the clavicle, and the knife being carried well behind each portion of the tendon in succession, the tendon will be divided on turning the edge of the knife towards it, and using it with a cutting motion, at the same time that the head is so held as to make the muscle tense. It is seldom necessary to divide other structures than the two portions of the muscle now indicated, except it be, perhaps, a band or two of fascia; for other contracted structures will probably yield to mechanical extension after the greater obstruction caused by the retracted sterno-mastoid muscle has thus been removed.

After the operation, the head is to be supported in such a manner that the chin inclines towards the breast; so that the little wounds may readily heal, and reunion of the divided tendon may take place. Then, on the fourth or the fifth day, extension, with a suitable instrument, may commence, and be carried on gradually, until the head is raised into its normal position; and, indeed, extension should proceed so far that power may be obtained to move the chin equally to one side or the other.

So soon as the position of the head is restored, care must be taken to remove the spinal curves. The child to whom allusion has already been made, and who is represented in Fig. 80, was only fourteen months old at the time of the operation; but even at that time there was already a dorsal curve of so

FIG. 80.

severe a character that it took much longer time to remove it than was required for the removal of the primary affection—wry-neck—for which she was admitted into the hospital.

# CHAPTER XX.

## ANGULAR CURVATURE OF THE SPINE.

Caries of the spine very frequently occurs as a result of inflammation, whether of a strumous or a rheumatic character. Disease of the spine is, however, essentially of a scrofulous nature. Any portion of the spinal column may be affected by this formidable disease; but the dorsal and the cervical portions of the spine are in children attacked more frequently than the lumbar portion. In more advanced life disease is not unfrequently of a mixed character—rheumatism in a strumous diathesis; and inflammation then is sometimes found to extend from the sacro-iliac articulation, and to affect the lumbar vertebræ.

Caries of the spine may commence at any period of life, for no age is exempt, and any portion of the spinal column may become diseased; but this is especially a disease of childhood; it partakes essentially of a scrofulous character, and because the dorsal region is the most extensive and the most exposed to injury, it is more frequently the seat of caries and angular curvature than either of the other regions. In its incipient stage disease of the spine is not unfrequently overlooked, whether in the child or in the adult; sometimes it is styled neuralgia, or, again, pain is supposed to arise from pulmonary disease.

And it is not alone in its incipient stage that disease is overlooked, for it is not uncommon to see that disease has progressed so far as to have resulted in deformity without caries of the spine being even suspected.

In this form of disease the anterior portion of the spinal column—namely, the bodies of the vertebræ, with the intervertebral substances and the intervertebral ligaments—is alone liable to become carious. The posterior segment, consisting of the spinous, transverse and oblique processes, with the pedicles and arches, shows but little disposition to pass into a similar state of disease.

An instance in which disease of the posterior segment of certain vertebræ occurred has been placed on record by Dr. Buckminster Brown, of Boston, U.S. I give the result of the *post-mortem* examination.

Body excessively emaciated. There was no curve nor projection of any part of the spinal column. On the anterior face of the bodies of the cervical vertebræ the cyst of an old abscess was found. This cyst contained no fluid, was about the size of a hen's egg, and through an opening formed by the removal of the body of the second vertebra, and which extended from the first to the third, it communicated with the rachidian canal between the dura mater and the arachnoid. It is probable that the collection of pus existed at first external to the membranes, and finally opened through the dura mater into its cavity, which accounts for the disappearance of the effused fluid. On opening into the upper part of the cyst, towards the medulla oblongata, a loose piece of carious bone, the size perhaps of half a filbert, rolled out of the medullary cavity. In the course of a careful dissection, another piece, much larger than the first, also loose and carious on all sides, was found. These were the remnants of the odontoid process, and of the body of the axis which was entirely destroyed or

removed, with the exception of a small lamina on the left side, which still remained attached to the semicircle of bone. The inferior articulating process on the right side was carious. The superior articulating process on the same side, and the transverse process with its vertebral foramen, were destroyed. The superior articulating process on the left side was carious, its articulating cartilage and capsular ligament had disappeared, and the caries extended over the lamella towards the posterior arch. Ascending to the atlas, the disease had destroyed both inferior articulating cartilages, and partially the processes, extending anteriorly round the condyles, upwards towards the superior condyles, and posteriorly through the left lamina of the posterior arch, breaking entirely through it at one point, and continuing on until it involved the posterior tubercle. In the occipital bone, the right articulating condyle and the basilar process were roughened, and in some places the continuity of the bone was destroyed.

The apex of the odontoid was found suspended by its alar ligaments in its normal situation. The occipito-axoid ligament which incloses the odontoid process was ulcerated through, thus permitting the fragments of this process to find their way into the vertebral canal. This process had been twice broken; once from its apex, which had been left adhering by its ligaments to the margin of the foramen-magnum, and once at its base, from the body of the dentatus, which had likewise separated from the rest of the bone.

It is evident that one of these fractures must have occurred at the time when a crack was heard and felt in the neck, followed by immediate luxation and the symptoms previously described.

The anterior face of the body of the third vertebræ was also affected with caries, and the intervertebral substance almost completely destroyed, together with a part of its right articular process, and the whole of its anterior pedicle, which should have inclosed the vertebral foramen.

Softening had likewise commenced in the cartilage between the bodies of most of the other cervical bones. Some, when in a fresh state, presented examples of central softening; and others, of well-defined ulcerated perforations, illustrative of the earliest stages of the disease when commencing in this part. The body of the sixth was deeply corroded, and the transverse processes of

the seventh somewhat so. There was a remarkable, almost translucent, thinness of some parts of the os occipitis.

The medullary substance in the cervical region was softened from the foramen-magnum to the first dorsal. The upper part was reduced to a pultaceous, semi-fluid mass. The medulla oblongata remained of its natural consistence and appearance. The brain was healthy. Tubercles were found in the lungs, and strong, old pleuritic adhesions on both sides.*

Disease of the spine is, for the most part, the result of injury, through which inflammatory action is set up and extends to the intervertebral substances and to the bodies of the vertebræ. In this respect the progress of the affection does not materially differ from that which is observed to take place in other articulations. In all strumous affections of bone tubercular matter is deposited in the medullary cavities and in the cancellous structure of the bones; but the bodies of the vertebræ, from their spongy texture, and also by reason of the accidents to which the spinal column is liable, are in a special manner prone to this condition of disease—scrofulous caries.

In an early stage of the disease, one spot in the course of the vertebral column is more or less acutely sensitive. After a time the character of the pain is altered, and a slight projection of a spinous process may be observed, with, perhaps, some tumefaction around the seat of disease. Caries may then be said to be established. The structure of one or more vertebræ having become disorganized, a gap of greater or less extent, according to the number of bodies of vertebræ involved in the disease, is formed, and the upper portion of the column falls forward.

* 'American Journal of the Medical Science.'

That vertebra whose body has been most excavated becomes the most prominent, and its spinous process forms the apex of the angular projection. The deformity which ensues is greatest in the dorsal, and least in the lumbar region. The greatest deformity from an equal amount of destruction occurs in the upper dorsal region. This is due to the shape of the vertebræ as well as to the formation of the vertebral curves; for the bodies of the dorsal vertebræ and the intervertebral substances of this region are thicker behind than in front, or the reverse of that which obtains in the cervical and lumbar regions, and the dorsal spine presents its convexity backwards; and, therefore, deformity from these several causes is necessarily greater in the dorsal than in the cervical or lumbar regions. But, also, the dorsal spines are long and superficial, and thus any increase of the curve increases the prominence of the spinous processes, and loss of substance, even to a smaller extent than in either of the other spinal regions, produces greater deformity in the dorsal region, and immediately occasions an angular appearance of the spine. On the other hand, in the lumbar region, the vertebræ, presenting a concavity backwards, with short spinous processes which are buried among powerful muscles while their bodies are broad and deep, allow of considerable loss of substance, with comparatively small deformity.

When disease is established in the cervical region, the head is somewhat thrown back, and is more or less fixed; the muscles are thrown into action to prevent motion and to avoid pain, and the head seems to subside on to the shoulders. Thus the

space is contracted between the occiput and the back. This is especially observable in children; but it is also to be noticed in adults. Also, the muscles of one side of the neck are sometimes more contracted than on the opposite side, and the head is in consequence inclined to one side or the other, as in wry-neck. This occurred in the following case.

Caroline S—, aged forty-three, was admitted into Princess's ward of St. George's Hospital, with her head firmly fixed and inclined to the right side; the ear was drawn towards the right shoulder, and the chin was projected in the opposite direction. The muscles on both sides of the neck were rigid, but they were much more contracted on the right than on the left side. Such, then, was the condition of the head when the patient entered the hospital. After the head had been efficiently supported for some few days, the muscles became relaxed and the wry-neck had disappeared, for the irritation had ceased.

Pain is a very variable symptom of this disease. When the ligaments are first affected, pain is acute: every movement causes pain. At length less pain is experienced, and finally it almost disappears. Pain, however, may be excited by pressure on the diseased bone or by percussion, until ankylosis is complete. To prevent the pain which is caused by motion, the child will move about with the hands resting on the thighs or on the knees, and he will stand with his hands or elbows resting on a table, thus to diminish the friction which is occasioned by one portion of the spinal column moving upon the other, and for support. At the same time the muscles of the back are thrown into action to fix as much as possible the affected parts, and thus to prevent movements and the pain which is caused by these

movements; in the same manner as is observed in all diseases of joints. Muscular rigidity takes place to a much greater extent in the cervical than in the other regions of the spine; and for this reason, that in a normal condition the flexibility of the cervical portion is much greater than any other portion of the spine.

As the substance of one or more of the bodies of the vertebræ is removed by caries, the upper portion of the column falls forward upon the lower. This displacement occurs in consequence of the chasm which has been produced in the column; so that the upper portion may be said to be left unsupported, and it therefore falls forward. Such muscles as the psoas, however, assist this action, when they become irritated. Although the muscles of the back are rigid, and tend to fix the spinal column so long as pain on motion exists, and before the chasm above alluded to is produced, they become atrophied in an advanced stage of the disease, when displacement of the column forward has taken place.

The amount of angular deformity which takes place depends, first, on the amount of destruction of the bodies of the vertebræ, and, secondly, on the position of the disease. But the extent of the disease, and consequently the amount of deformity, depend on the treatment to which the patient may have been subjected. It is possible that little or no apparent deformity shall remain, even when the upper dorsal region has been affected. Disease must then have been grappled with, however, at an early stage, and perseveringly.

When several vertebræ become affected, so that

the chasm in the column which results is considerable, an angle more or less acute is produced, and the canal itself may be encroached upon. This encroachment may occasion pressure on the cord; which, if it take place suddenly or increase rapidly, will be followed by paralysis. When, however, deformity increases slowly, the cord becomes so tolerant of pressure that perhaps loss of power will not ensue. In these cases, partial paralysis is apt to occur when motion is permitted. And, again, power is restored by continued rest of the body. There was lately, in Drummond ward of St. George's Hospital, an instance in point. In this case disease was limited to the lower dorsal region, and there was very slight displacement; so little, indeed, that when lying down scarcely any projection of the spinous processes could be observed. It was, however, conspicuous enough when the patient stood up. It was not possible to keep this patient always lying down: she would occasionally get out of bed. And when this occurred, violent twitchings of the lower limbs followed these efforts, and they lasted, perhaps with acute pain, for twenty-four or more hours, when they would cease and the limbs again become motionless and flexed upon the trunk; then gradually the muscles would relax and the limbs resume their normal condition, and motion and sensation again be perfectly restored. This is not altogether an ordinary case, but I allude to it inasmuch as it illustrates certain points in the course of spinal disease.

In the case from which Fig. 81 was taken the bodies of at least five or six vertebræ have been entirely destroyed; but, notwithstanding the great deformity

which has been produced, symptoms of compression of the cord have never been experienced.

For the most part, when destruction of the bodies of the vertebræ has taken place rapidly, paraplegia will be more or less complete when movements of

FIG. 81.

the body are permitted; but when destruction has taken place slowly, little or no muscular weakness may result. Whenever motion is allowed in disease of the spine, a sense of weakness or pain is experienced at the seat of disease; and this is always increased by percussion or by firm pressure. Somewhat later, painful twitchings are produced by

movements of the trunk, and afterwards sensation becomes somewhat blunted. Tenderness begins to be felt in the course of the psoas muscle, or otherwise in the loins or neck, according to the seat of disease; and presently a slight swelling, communicating a doughy sensation, may be perceived, which increases according to circumstances to larger dimensions.

When paralysis occurs, motion is first lost, and subsequently sensation; and it occurs thus for the obvious reason that the anterior columns of the cord, which give off the nerves of motion, are more subjected to pressure and irritation, lying, as they do, more immediately in contact with the carious bone than the posterior columns, from which the nerves of sensation are given off. Paralysis is not, however, as I have already shown, in proportion to the amount of deformity, but rather in proportion to the rapidity of the change which is effected.

When disease occurs in the lumbar region, it is sometimes attended with considerable pain, but rarely with much deformity. In the dorsal region, the great length of the spinous processes, and the forward curve which this portion of the column assumes, tend to make any projection of the dorsal spine remarkable. The thorax undergoes considerable change of form: the sternum is rendered prominent, while the ribs are compressed laterally, and project backwards together with the vertebræ. In such cases, the least hurry or excitement causes palpitation.

When disease occurs in the cervical region, the head may be held forward, or it may be turned to

one side, and so be fixed, as in wry-neck. And, indeed, disease in this region may so closely simulate ordinary wry-neck that an error of diagnosis may easily be committed. Generally, however, the head falls back, and the child is unable to raise it. In these cases, any movements of the head, especially sudden or rotatory movements, cause excruciating pain; and even sudden death has been occasioned by such movements—namely, where the atlas and the axis were involved in the disease. Under such circumstances the spinal cord in its specially vital portion may be crushed between the atlas and the odontoid process. Occasionally, two portions of the spinal column are simultaneously attacked with caries. Such cases are rare, however, and their treatment differs in nothing from others which are more simple.

Spinal abscess, when it forms in the cervical region, presents itself between the muscles at the side of the neck, or the pus may burrow somewhat lower down, and the abscess will probably point opposite to the dorsal vertebræ. And when the dorsal vertebræ are affected with disease, the pus either gravitates in the course of the posterior mediastinum, and passes along the psoas muscle, to point in the groin, whence it may burrow even to the knee; or the abscess, being deflected backwards, will appear in the loin, when it is known as lumbar abscess. Again, the pus may pass along an intercostal space, and come to the surface on the side of the thorax; or it may burst into the intestine, as, for instance, into the sigmoid flexure of the colon, and be evacuated *per rectum*. Under such circum-

stances I have known the patient to sink in the course of some few hours. Insensibility may ensue immediately on such a discharge taking place, and death may follow in two or three hours after. Instead of finding its way beneath Poupart's ligament, the pus may be arrested in its course, and collect in the iliac fossa, where it is sometimes found in large quantities. The effects now detailed are the results of motion. It is obvious, therefore, how they should be prevented.

*Treatment.*—The treatment of disease of the spine does not differ materially from that which is indicated for scrofulous joints generally—namely, rest of the part affected.

A limb may be kept at rest by means of a suitable splint, and when the joint is thus secured, the patient can move about without fear of injury, so long as the limb is not used. It is not so, however, with the spine. Only the posterior surface of the spine can be efficiently supported, and, therefore, the trunk cannot be perfectly fixed and friction of the opposed surfaces of the carious bodies of the vertebræ prevented, except in the recumbent posture. This is the position, then, which should be constantly observed in disease of the spine. But this is not alone sufficient, for it is required to keep the trunk motionless, so that friction of the diseased surfaces shall be avoided. This can only be effected by means of a well-adapted splint, which shall grasp the pelvis and shoulders, and if necessary the neck and occiput. As a further precaution, the mattress on which the patient lies may be slightly hollowed to receive the splint. The most convenient couch

for this purpose is a double inclined plane, by means of which the shoulders and knees may be gently raised or lowered at pleasure. Such movements add greatly to the comfort of the patient.

The supine position is preferable to the prone position, for it can be continued longer without movement, and is, therefore, more favorable to ankylosis. But whatever the posture may be, absolute rest in the recumbent position is an undoubted necessity. Professor Pirrie has put this point well. He says, "Rest of the diseased parts and the recumbent position, whether the body be prone or supine, are of the utmost importance from the very commencement of the disease, until a cure is effected by ankylosis."*

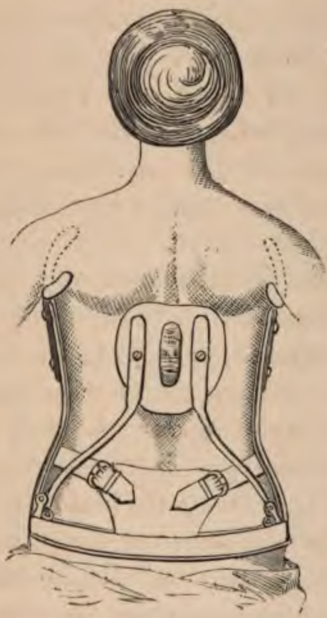
The importance of this fact—rest in the recumbent position — cannot be too much insisted on. Without it, all other treatment is useless; but with it, I have never known an abscess to form. The time which is required for this absolute rest depends on the previous duration of disease: probably eight or ten months may be sufficient when treatment is undertaken at an early period; but the necessary time will increase in proportion as disease has advanced. Without rest in the recumbent position, ankylosis can never take place.

Ankylosis, then, is the cure to be effected. And when this has taken place, a portable instrument may be worn to support the spine and remove the weight of the head and shoulders. (See Fig. 82.) Now that the upright position is again assumed,

* 'Principles of Surgery,' Second Edition, p. 463.

two incurvations of the spine will be observed—one above and the other below the seat of disease. These are essential for the equilibrium of the body; and they can only be formed after ankylosis has taken place. Thus these curves become proofs that ankylosis is more or less complete.

FIG. 82.



There is a spurious as well as a true ankylosis, however; and this consists of ossific union in the course of the posterior surface of the spine, which leaves the spaces of the bodies gaping. This form of union is promoted by the prone couch: it is slender, and liable at any moment to yield.

When unfortunately, and as the result of motion

and increased irritation, pus accumulates in such quantity that an abscess shows itself externally, whether in the groin, the loin, or elsewhere, it should never be allowed to break; but it should be opened when evacuation of the contents becomes absolutely necessary, through a small valvular opening; and thus tension may be removed by the withdrawal of a small quantity of matter, when the opening may be again closed. This operation may be repeated as it becomes necessary. Again, the contents of the sac may be evacuated, and a solution of carbolic acid may be injected. I prefer the latter mode of treatment; for the pus is then removed instead of being absorbed, and necessarily less danger attaches to such a course. Without motion, as has been already said, the abscess would not have formed. If motion be allowed after the contents of the abscess have been evacuated, it will again fill. Therefore, whether before the formation of abscess or after its evacuation, the rule for our guidance in these cases is always the same—rest in the recumbent position.

The following cases will place in a sufficiently strong light the advantage of complete rest:

In May, 1858, I saw with Dr. Burrows, Mr. Else, and Mr. Sargent, a gentleman 26 years of age, who, while riding in Ireland to Parsonstown, met with an injury through his horse slipping, or rather a hind leg giving way. He was severely jerked, and immediately pain was felt at the junction of the cervical with the dorsal vertebræ. He continued his ride notwithstanding, and subsequently walked through a part of Ireland. This took place in September, 1857. He returned home complaining of pain in

his neck. He would not follow the advice which was offered him, but moved about as formerly. In January, 1858, pain having increased considerably, he consented to lie down; but even now he rose often from his couch to walk from room to room.

In May I found the fourth dorsal vertebra prominent and carious, and the seventh cervical unusually movable. I insisted strongly, as had been done before, on complete immobility, but it was in vain; he would invariably walk from room to room when he considered it necessary. In July he lost partially the power of the lower limbs and the command of the sphincter ani. In August the intercostal muscles became paralysed, and he died in September.

Dr. Gull, who had seen him previously, was present at the *post-mortem* examination, and he wrote to me, "The intervertebral cartilage, between the fourth and fifth dorsal vertebræ was destroyed, and the adjacent bodies were extensively carious." And in addition, Mr. Sargent remarked "that a portion of the body of the fourth dorsal vertebra came away as if it were completely detached, and the medulla spinalis was compressed and softened for the space of one inch."

In August, 1861, I saw, with Dr. Beale, and with the patient's father, a medical practitioner, at Liverpool, and subsequently with Dr. Little, a gentleman 26 years of age, who two years previously had hurt his back while stooping. His back had remained "stiff" since that time, and when I saw him there was an abscess occupying the lumbar region, and the four lower dorsal vertebræ were carious. He had jnst taken his passage to China, but he was at once told that

he must give up any idea he might entertain of going to China, and that he must lie down without moving as his only hope of recovery. When he was fully satisfied of the necessity of this measure he carried it out with such a firm will that he scarcely moved until firm ankylosis had taken place. All pain subsided, the abscess entirely disappeared, and his general health was restored in a short time after he began to lie down. In the course of time he recovered his health perfectly: he was quite upright, and strong and active, with scarcely any projection of the vertebræ. In 1869 he married.

Such, then, is the mode of treatment to be adopted in these cases of disease of the spine, where the surgeon can do so little for his patient, but nature so much if rightly directed. When the recumbent position is maintained until ankylosis is complete, the future of such a patient may be as useful, and I might almost say, as vigorous as though disease had not occurred. But that this may result, treatment must have commenced early, and have been insisted on resolutely. There can be no dallying with this form of disease. If the patient and the surgeon are together resolved that there shall be no movements of the body until ankylosis is complete, the patient will rise from his couch fit almost for the enjoyment of life; and if there has been no rising on the elbow and no walking, but absolute and continued inaction during the whole period of lying down, the future of such an one will probably be scarcely less vigorous than it would have been had he not suffered from caries of the spine.

There is no difficulty in carrying out this treat-

ment with children. The improvement that takes place is immediately obvious, so that a parent is anxious to continue it. Nor is there difficulty either when the patient is older. He requires of course an explanation, but when he finds that it is to his own interest to carry out the advice which is tendered, he will, I believe, almost always do it earnestly. Certainly, if after the whole matter has been laid before him, he refuses to believe, or he doubts, and consequently moves about, he can only blame himself; but such cases are very rare. Usually the patient, either man or woman, will, in this vital matter, act as is obviously for his own advantage.

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